



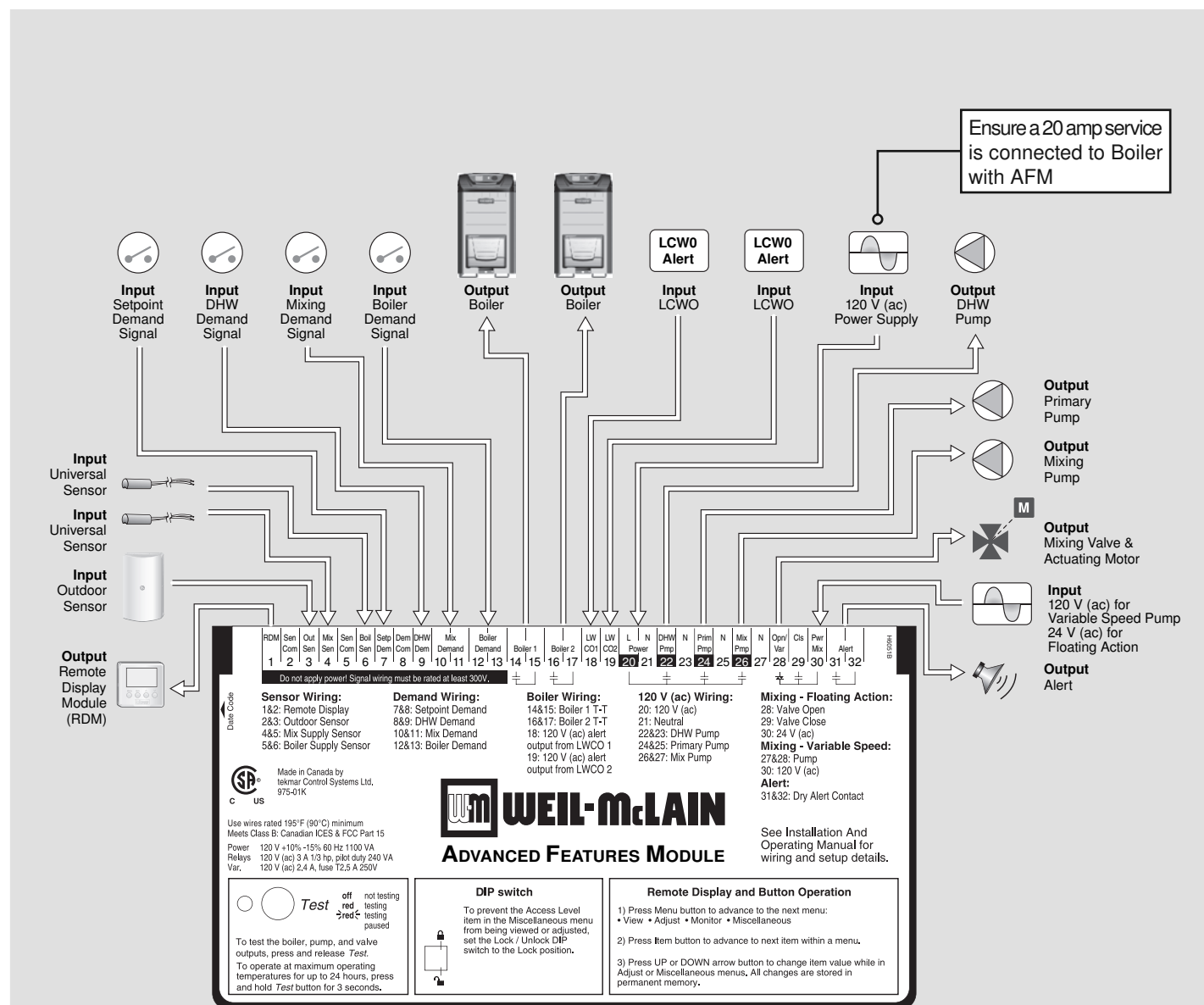
Advanced Features Module (AFM)

# INSTALLATION AND OPERATING MANUAL

The Advanced Features Module (AFM) can operate either one or two Ultra Oil boilers and operate a single mixing device to provide outdoor reset to the space heating system. When operating two Ultra Oil boilers, the AFM provides staging and equal run time rotation. The AFM can operate either an actuated mixing valve or a variable speed injection pump as the mixing device.

## Features:

- Boiler Outdoor Reset
- Mixing Outdoor Reset
  - variable speed pump
  - mixing valve
- Indirect Domestic Hot Water Operation (Optional priority)
- Setpoint Operation
- Low Water Cut Off Alert
- Two Boiler Operation with Equal Run Time Rotation
- Powered Pump Outputs
- Alert Contact
- Freeze Protection
- Boiler - Mounted Display



## How To Use The Manual

This manual must be used in conjunction with the Ultra Oil boiler manual. It is organized into five main sections. They are: 1) Sequence of Operation, 2) Applications, 3) Installation, 4) Control Settings, and 5) Testing & Troubleshooting. The Sequence of Operation section has seven sub sections. We recommend reading Section A: General of the Sequence of Operation, as this contains important information on the overall operation of the control. Then refer to the sub sections that apply to your installation.

The Control Settings section of this manual illustrates the menu screens that are shown on the Remote Display Module (RDM). These menu settings are referenced to the specific section in the Sequence of Operation.

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## User Interface

The Advanced Features Module (AFM) uses a Remote Display Module (RDM) as the method of supplying information. The RDM is used to setup and monitor the operation of the system. The RDM uses four push buttons (Menu, Item, Up, Down) for selecting and adjusting settings. As the AFM is programmed, record the settings in the actual settings column of the Adjust Menu. The table is found in the second half of this manual.

### Menu

All of the items displayed by the RDM are organized into various menus. These menus are listed on the left hand side of the display (Menu Field). To select a menu, use the Menu button. By pressing and releasing the Menu button, the display will advance to the next available menu. Once a menu is selected, there will be a group of items that can be viewed within that menu.

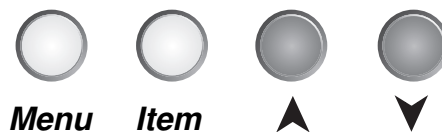
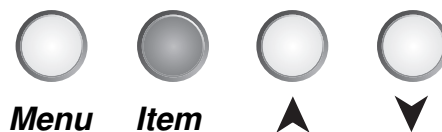
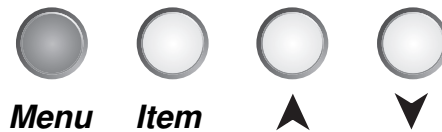
### Item

The abbreviated name of the selected item will be displayed in the item field of the RDM. To view the next available item, press and release the Item button. Once the last available item in a menu has been reached, pressing and releasing the Item button will return the display to the first item in the selected menu.

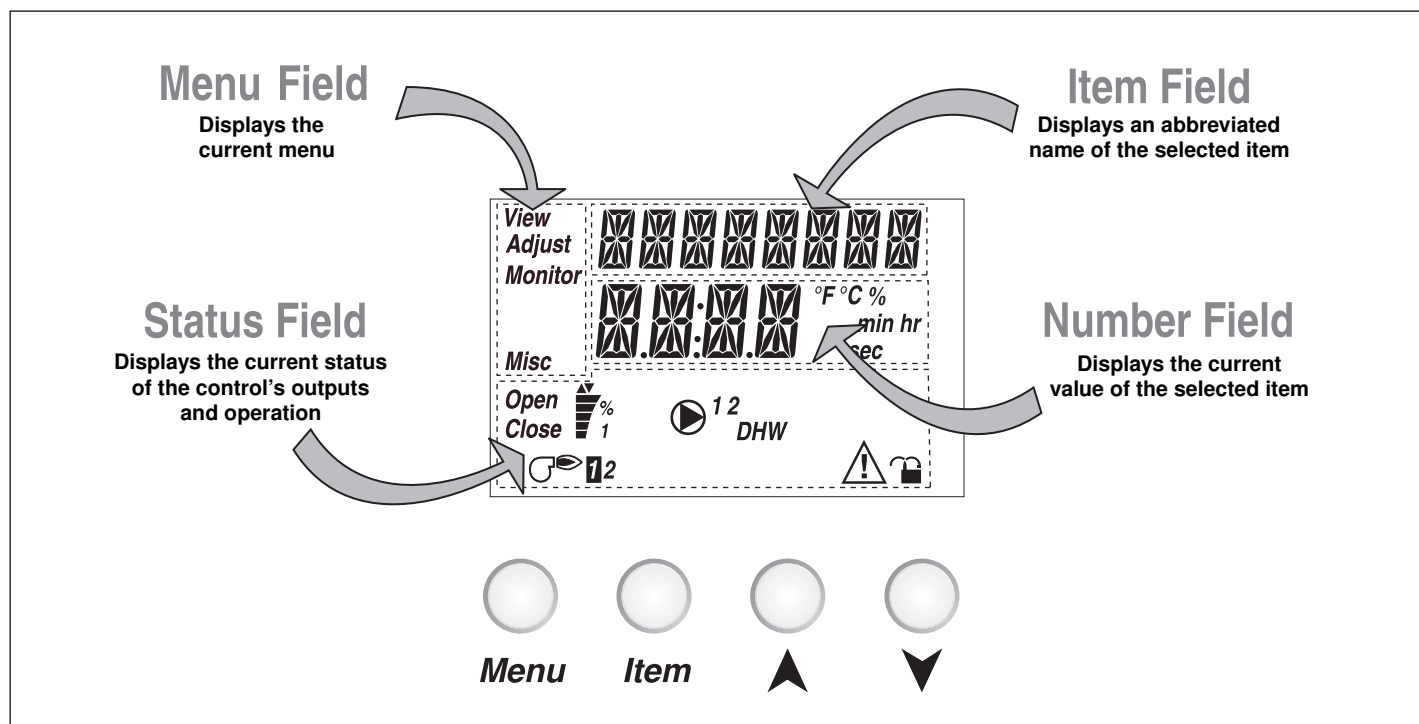
### Adjust

To make an adjustment to a setting on the RDM, begin by selecting the appropriate menu using the Menu button. Then select the desired item using the Item button. Finally, use the Up and/or Down button to make the adjustment.

Additional information can be gained by observing the Status field of the RDM. The status field will indicate which of the AFM's outputs are currently active. Most symbols in the status field are only visible when the View Menu is selected.



## Display



## Symbol Description

	<b>BURNER</b> Displays when boiler 1 and/or boiler 2 are operating.		<b>MIXING DEVICE OUTPUT SCALE</b> Indicates output of injection pump or mixing valve.
	<b>PUMP 1</b> Displays when the primary pump is operating.		<b>LOCK / UNLOCK</b> Displays whether the access levels are locked or unlocked.
	<b>PUMP 2</b> Displays when the mix pump is operating.		<b>WARNING</b> Displays when an error message exists or when a limit has been reached.
	<b>DHW PUMP</b> Displays when the DHW pump is operating.		<b>°F OR °C</b> Units of temperature.
	<b>OPEN / CLOSE</b> Displays when the actuator is opening or closing the mixing valve.		<b>MIN, HR, SEC</b> Units of time.

## Definitions

The following defined terms and symbols are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.



- Warning Symbol: Indicates presence of hazards which can cause severe personal injury, death or substantial property damage if ignored.

### INSTALLATION CATEGORY II

- Local level, appliances

# Sequence of Operation

**Section A**  
General  
Operation  
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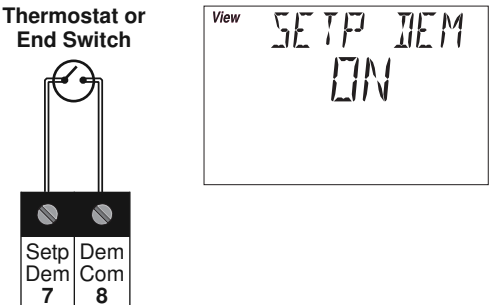
## Section A: General Operation

### TYPES OF DEMANDS

The AFM can control the boiler supply water temperature and the mix supply water temperature. The type of demand the control receives determines the operation of the control.

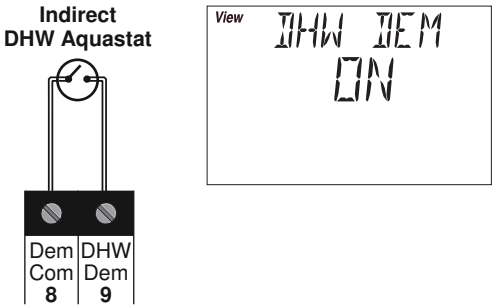
#### Setpoint Demand

When a Setpoint Demand signal is present, the AFM operates the boiler(s) to maintain the supply water temperature at least as hot as the Setpoint setting. The Setpoint Demand item in the View Menu will show "ON".



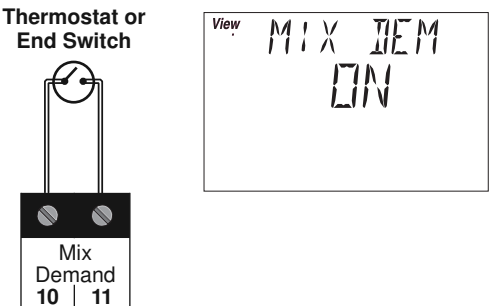
#### DHW Demand

When a DHW Demand is present, the AFM operates the boiler(s) to maintain the supply water temperature at least as hot as the DHW exchange setting. The DHW Demand item in the View Menu will show "ON".



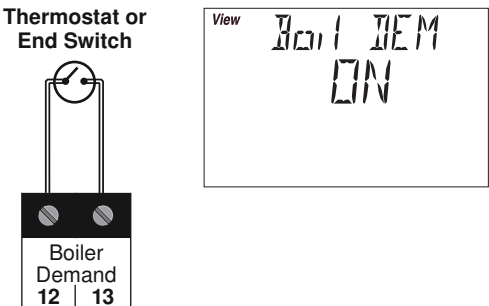
#### Mix Demand

When a mix demand signal from the heating system is present, the AFM operates the mixing device and the boiler(s) to maintain the mix supply temperature based on the outdoor air temperature and the Mix Characterized Heating Curve settings. The Mix Demand item in the View Menu will show "ON".



#### Boiler Demand

When a boiler demand signal from the heating system is present, the AFM operates the boiler(s) to maintain the boiler supply temperature based on the outdoor air temperature and the Boiler Characterized Heating Curve settings. The Boil Demand item in the View Menu will show "ON".



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## Status

The status item in the View menu shows the AFM operating status.

**WWSD** = AFM in Warm Weather Shut Down

**B.MIN** = The boiler is operating near or at the Boiler Minimum temperature. The mixing device will operate at a low percentage to protect the boiler.

**B.MAX** = The boiler is operating near or at the Boiler Maximum temperature.

**M.MIN** = The mixing system is operating near or at the Mixing Minimum temperature.

**M. MAX** = The mixing system is operating near or at the Mixing Maximum temperature.

**ON** = The AFM has a demand present and the above conditions do not apply.

**OFF** = The AFM has no demand present and the above conditions do not apply.

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## Outdoor Design Temperature

The outdoor design temperature is the typical coldest outdoor air temperature of the year. This temperature is used when doing the heat loss calculations for the building. If a cold outdoor design temperature is selected, the supply water temperature rises gradually as the outdoor temperature drops. If a warm outdoor design temperature is selected, the supply water temperature rises rapidly as the outdoor temperature drops.

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## Warm Weather Shut Down

When the outdoor air temperature rises above the Warm Weather Shut Down (WWSD) setting, the Status item in the View menu will show WWSD. When the AFM is in Warm Weather Shut Down, the Mix Demand and Boiler Demand do not operate the heating system to satisfy these demands. The AFM does respond to a DHW Demand and/or Setpoint Demand.

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## Exercising

The AFM has a built-in pump and valve exercising function that occurs every 72 hours.

If a pump or valve output on the AFM has not been operated at least once during every exercising period, the AFM turns on the output for 10 seconds. This minimizes the possibility of a pump or valve seizing during a long period of inactivity.

In the case where a mixing valve is being used as the mixing device, the AFM ensures that the valve operates over its entire range at least once each exercising period.

**Note:** The exercising function does not work if power to the AFM, pumps or valves is disconnected.

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## Boiler Protection

The AFM is capable of providing boiler protection from cold mixing system return temperatures. The AFM protects the boilers by either reducing the variable speed injection pump speed or by closing the mixing valve. This limits the amount of cool return water to the boiler and allows the boiler water temperature to recover.

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## Alert Contact

The AFM has an alert dry contact that can be used to connect to monitoring equipment such as a security system. The alert dry contact is closed whenever an error message is created and shown on the Remote Display Module. The alert dry contact remains closed until the error message is corrected and cleared from the RDM display.

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## Freeze Protection

The AFM provides boiler freeze protection for the boilers. Once the boiler supply sensor reaches 40°F (4.5°C) the AFM switches on the primary pump and fires the boiler(s). Once the boiler supply sensor reaches 45°F (7.0°C), the primary pump is switched off and the boiler(s) are staged off.

**Important Note:** Depending on the method of installation, the primary pump may not be used. In these cases, the boiler(s) may cycle on the high limit aquastat.

## Section B: Boiler Operation

### BOILER TARGET TEMPERATURE

In order for the AFM to fire the boiler(s), a Boiler Demand, Mix Demand, DHW Demand or a Setpoint Demand must be present. A boiler target temperature will be determined based upon the type of demand present and in some cases, on outdoor temperature. When a demand is not present, the RDM will display “— —” as the boiler target.

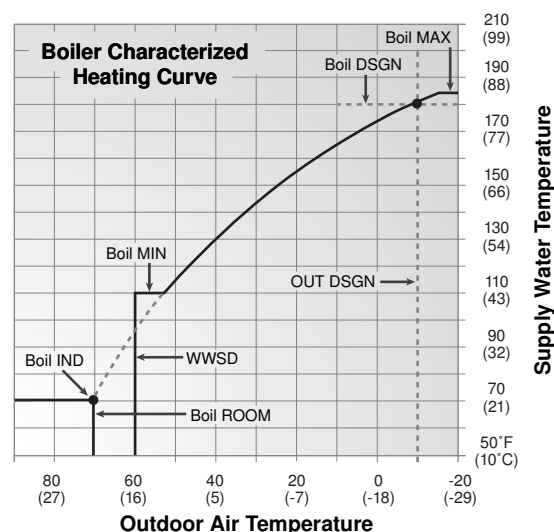
### FIXED BOILER TARGET OPERATION

The outdoor reset operation is disabled when the Outdoor Design setting is set to Off. In this case, a Boiler Target setting is available in the Adjust menu. This allows the installer to manually set the boiler target temperature. When a Boiler Demand is present, the boiler(s) are operated at this temperature.

### BOILER OUTDOOR RESET OPERATION

When a Boiler Demand is present and the Outdoor Design settings is set to a temperature, the AFM uses the following settings to determine the boiler target temperature:

- Boiler Design
- Boiler Indoor Design
- Boiler Room



### Boiler Design Temperature

The Boiler Design supply temperature is the supply water temperature required to heat the building when the outdoor air temperature is as cold as the outdoor design temperature.

### Boiler Indoor Design Temperature

The Boiler Indoor Design temperature is the room temperature that was used in the original heat loss calculations for the building. This setting establishes the beginning of the boiler characterized heating curve.

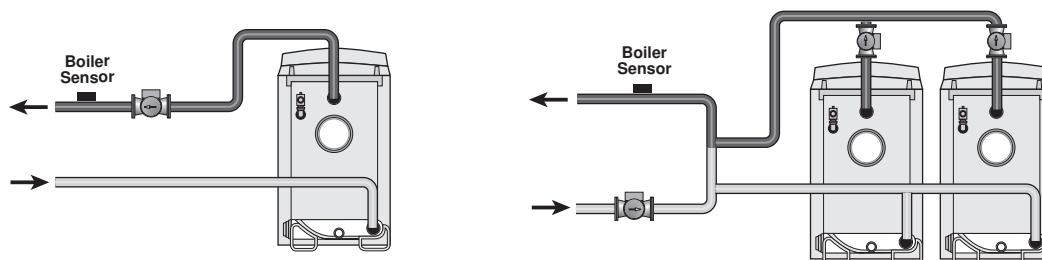
### Boiler Room

The Boiler Room setting is the desired room temperature for the building and provides a parallel shift of the boiler characterized heating curve.

The room temperature desired by the occupants is often different from the design indoor temperature. If the room temperature is not correct, adjusting the Boil Room setting increases or decreases the amount of heat available to the boiler zones in the building.

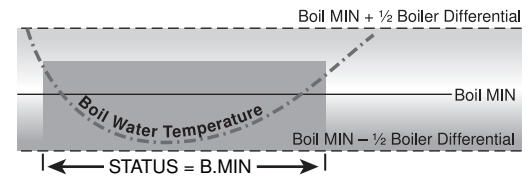
### BOILER SUPPLY SENSOR

The AFM will operate the boiler(s) in order to maintain the boiler target temperature at the boiler supply sensor location. The boiler supply sensor is located on the boiler outlet when a single boiler is installed. In applications with two boilers, the boiler supply sensor must be located downstream of the point where the two boiler's outlets tie together.



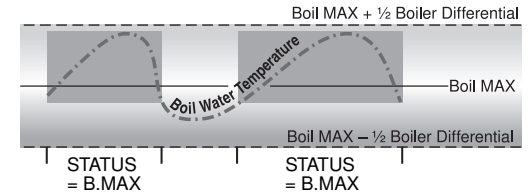
## BOILER MINIMUM

The boiler minimum is the lowest temperature that the AFM is allowed to use as a boiler target temperature. During mild conditions, if the AFM calculates a boiler target temperature that is below the boiler minimum setting, the boiler target temperature is adjusted to at least the boiler(s) minimum setting. During this condition, if the boiler(s) is operating, the Status item in the View menu will display "B.MIN".



## BOILER MAXIMUM

The boiler maximum is the highest temperature that the AFM is allowed to use as a boiler target temperature. If the AFM does target the boiler maximum setting, and the boiler temperature is near the boiler maximum temperature, the Status item in the View menu will display "B.MAX". At no time does the AFM operate the boiler(s) above 220°F (105.0°C).



## STAGING

The AFM controls up to two boilers in order to supply the required target temperature. After the first boiler is turned on in the firing sequence, the control waits a minimum amount of time before turning on the second boiler. This is known as the stage delay. After the minimum time delay between stages has expired, the AFM examines the control error to determine when the second boiler is to fire. The control error is determined using Proportional, Integral, and Derivative (PID) logic.

**Proportional** - compares the actual supply temperature to the boiler target temperature. The colder the supply water temperature, the sooner the second boiler is turned on.

**Integral** - compares the actual supply temperature to the boiler target temperature over a period of time.

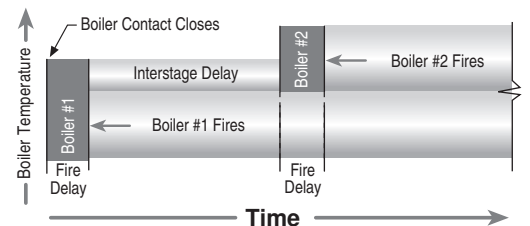
**Derivative** - determines how fast or slow the supply water temperature is changing. If the supply temperature is increasing slowly, the second boiler is turned on sooner. If the supply temperature is increasing quickly, the second boiler is turned on later, if at all.

Each stage has a minimum on time and a minimum off time.

## STAGE DELAY

The Stage Delay setting affects the rate at which the AFM stages the second boiler. The stage delay is defined as the time from the first boiler firing to the time the second boiler fires. There are three settings:

1. The minimum time between the boilers staging on is 2 minutes. This stages the second boiler at an aggressive pace.
2. The minimum time between the boilers staging on is 4 minutes. This stages the second boiler at a moderate pace.
3. The minimum time between the boilers staging on is 6 minutes. This stages the second boiler at a slow pace.

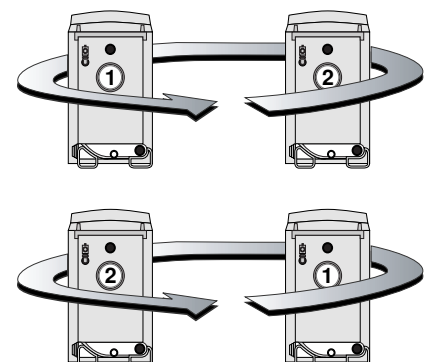


## BOILER 1 AND 2

The Boiler 1 and 2 setting may be selected to either Auto or Off. When Auto is selected, the boiler is activated and the AFM is able to fire the boiler when required. When Off is selected, the AFM does not fire the boiler.

## EQUAL RUN TIME ROTATION

The Equal Run Time Rotation feature changes the firing order of the boilers whenever one boiler's accumulated running time exceeds the other boiler's accumulated running time by more than the Rotate setting. The factory default is 48 hours. After each rotation, the boiler with the least running hours is the first to fire and the boiler with the most running hours is the last to fire. This function ensures that both boilers receive equal amounts of use. When this item is set to the Off setting, Boiler 1 is always the first to fire.

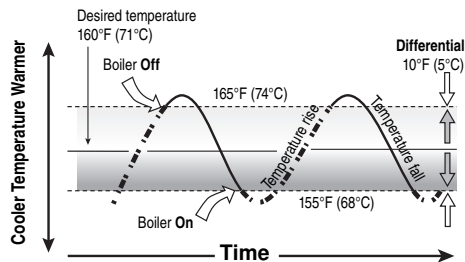


## BOILER DIFFERENTIAL

An on/off heat source must be operated with a differential in order to prevent short cycling. With the AFM, either a fixed or an auto differential may be selected.

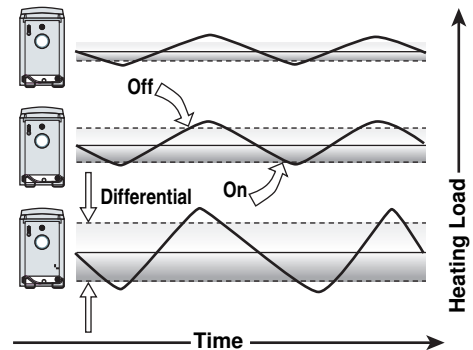
### Fixed Differential

The boiler differential is divided around the Boiler Target temperature. The first boiler contact will close when the supply water temperature is 1/2 of the differential setting below the Boiler Target temperature, and will open when the supply water temperature is 1/2 of the differential setting above the Boil Target temperature. The second boiler operates if the first boiler cannot bring the water temperature up to the Boiler Target temperature.



### Auto Differential

If the Auto Differential is selected, the AFM automatically determines the best differential as the load changes. Under light loads, the differential is increased in order to reduce the potential of short cycling. Under high loads, the differential is decreased in order to reduce temperature swings.



## Section C: DHW Operation

### DHW DEMAND

When an indirect domestic hot water tank aquastat closes its contact, it activates the DHW Demand.

### BOILER TARGET DURING DHW GENERATION

When a DHW Demand is present the boiler target temperature is at least as hot as the DHW exchange setting. The DHW Demand overrides the boiler reset target temperature, except when the boiler reset target is higher than the DHW exchange setting.

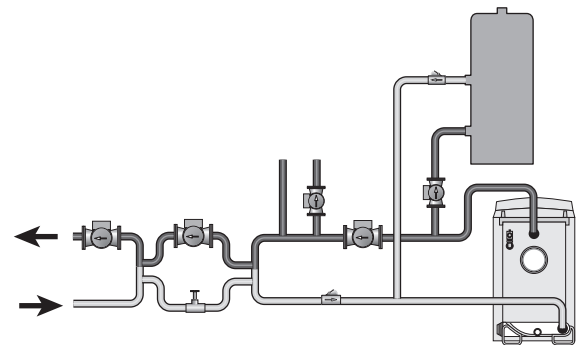
### DHW MODE AND PRIORITY OPERATION

The AFM has three different settings available for DHW Mode. The required DHW Mode setting depends on the piping arrangement of the DHW tank. It is often desirable to limit or even stop the flow of heat to the heating system when the DHW tank calls for heat. This allows for a faster recovery of the DHW tank.

#### DHW MODE 1 - DHW in Parallel no Priority

When a DHW Demand is present, the DHW Pump is powered. The primary pump does not turn on, but may operate based on either a Boiler Demand, Mix Demand or a Setpoint Demand.

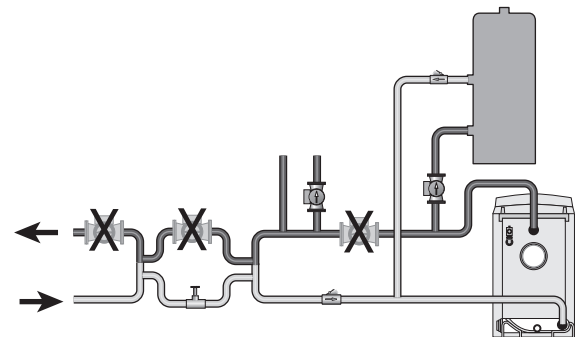
It is assumed that the DHW pump will provide adequate flow through the heat exchanger and the boiler.



#### DHW MODE 2 - DHW in Parallel with Priority

When a DHW Demand is present, the DHW pump is powered and the primary pump is forced to shut off, thereby providing the DHW tank with full priority.

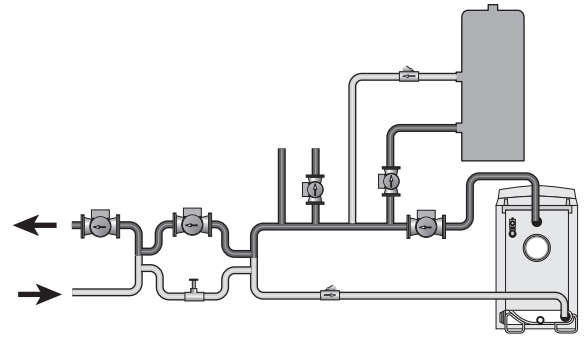
It is assumed that the DHW pump will provide adequate flow through the heat exchanger and the boiler.





### DHW MODE 3 - DHW in Primary/Secondary no Priority

When a DHW Demand is present, the DHW pump and the primary pump are powered.



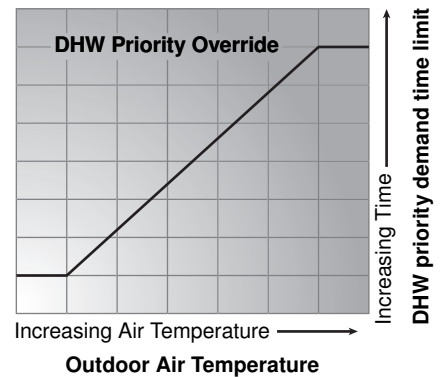
## DHW PRIORITY FEATURES (DHW Mode 2)

### DHW Priority Override

To prevent the building from cooling off too much or the possibility of a potential freeze up during DHW priority, the AFM limits the amount of time for DHW priority. As the outdoor air temperature becomes colder, the length of time that the AFM provides DHW priority is reduced. Once the allowed time for priority has elapsed, the AFM overrides the DHW priority and operates DHW and heating simultaneously.

### Conditional DHW Priority

If the boiler supply temperature is maintained at or above the required temperature during DHW generation, this indicates that the boiler(s) has enough capacity for DHW and possibly heating as well. As long as the boiler supply temperature is maintained near its target, DHW and heating occurs simultaneously.

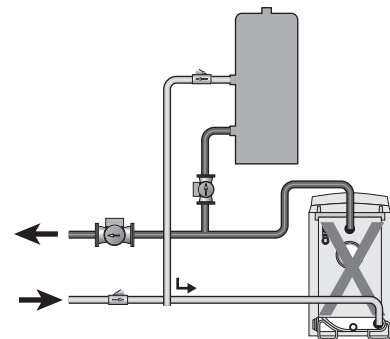


### DHW Post Purge

After the DHW Demand is removed, the AFM performs a purge on the boiler(s). The AFM shuts off the boiler(s) and continues to operate the DHW pump. This purges the residual heat from the boiler(s) into the DHW tank. The AFM continues this purge for a maximum of two minutes or until the boiler supply water temperature drops 20°F (11°C) below the DHW Boil Target temperature. The AFM also stops the purge if the boiler supply temperature drops below the current Boil Target temperature.

### DHW Mixing Purge

After DHW operation, the boiler(s) is extremely hot. At the same time, the heating zones may have cooled off considerably after being off for a period of time. To avoid thermally shocking the boiler(s) after DHW priority, the AFM shuts off the boiler(s), but continues to operate the DHW pump while restarting the heating system. This allows some of the DHW return water to mix with the cool return water from the zones and temper the boiler return water.



## Section D: Setpoint Operation

The AFM can operate to satisfy the requirements of a setpoint load in addition to a space heating load and a DHW load. A setpoint load overrides the current outdoor reset temperature and WWSD setting in order to provide heat to the setpoint load. When the setpoint device closes a contact, it activates the Setpoint Demand.

### BOILER TARGET DURING SETPOINT DEMAND

The Boiler Target temperature during a Setpoint Demand is increased to at least the Setpoint setting. This temperature is maintained as long as the Setpoint Demand is present.

### SETPOINT MODES

The AFM has two different settings available for Setpoint Mode. The required Setpoint Mode setting will depend on the piping arrangement of the setpoint device.

#### Mode 1 - Setpoint in Parallel

Whenever a Setpoint Demand is present, the boiler(s) is operated to maintain the setpoint target. The primary pump does not turn on, but may operate based on either a Boiler Demand, Mix Demand, or a DHW Demand.

It is assumed that the setpoint pump will provide adequate flow through the boiler.

#### Mode 2 – Primary Pump during Setpoint

Whenever a Setpoint Demand is present, the primary pump is powered and the boiler(s) is operated to maintain the setpoint boiler target.

## Section E: Mixing Operation

The AFM is capable of providing a reset supply water temperature from the primary boiler loop to a secondary mixed loop using a mixing device. The mixing zones that are piped into the mixed loop and receive a mixed supply temperature. The mix supply temperature is determined using a Mix Characterized Heating Curve. In order to set up a Mix Characterized Heating Curve, the following information must be entered into the AFM using the Adjust menu.

### MIX DESIGN

The Mix Design temperature is the supply water temperature required to heat the mixing zones when the outdoor air is as cold as the Outdoor Design temperature. This setting establishes the end point of the Mix Characterized Heating Curve for the mixing zones.

### MIX INDOOR

The Mix Indoor setting is the room temperature used in the original heat loss calculations for the building. This setting establishes the beginning of the Mix Characterized Heating Curve for the mixing zones.

### MIX ROOM

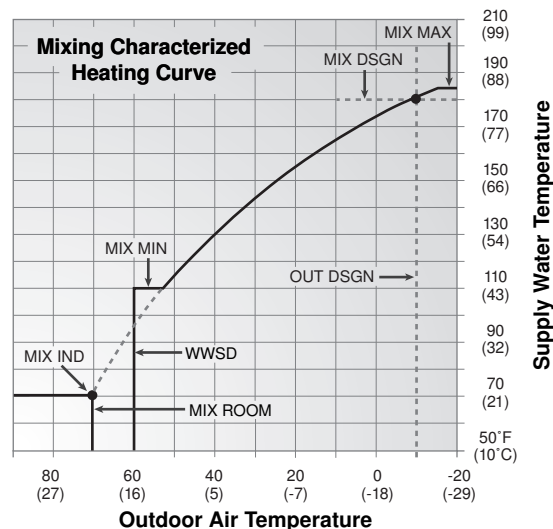
The Mix Room setting is the desired room temperature for the mixing zones and it provides a parallel shift of the Mix Characterized Heating Curve. The room temperature desired by the occupants is often different from the designed indoor temperature. If the room temperature is not correct, adjusting the Mix Room setting increases or decreases the amount of heat available to the building.

### MIX TARGET TEMPERATURE

The Mix Target temperature is determined from the Mix Characterized Heating Curve settings. The AFM displays the temperature that it is currently trying to maintain as the mix supply temperature. If the AFM does not presently have a Mix Demand, it displays “— —” on the RDM.

### MIX MINIMUM

The Mix Minimum setting is the lowest temperature that the AFM is allowed to use as a mix target temperature. During mild conditions, if the AFM calculates a mix target temperature that is below the Mix Minimum setting, the mix target temperature is adjusted to match the Mix Minimum setting. During this condition, if the mixing supply temperature is near the Mix Minimum setting, the Status item in the View menu will show “M.MIN”.



## MIX MAXIMUM

The Mix Maximum sets the highest water temperature that the AFM is allowed to use as a mix target temperature. If the AFM does target the mix maximum setting, and the mix supply temperature is near the mix maximum temperature, the Status item in the View menu will show "M.MAX".

## BOILER MINIMUM PROTECTION

The AFM is capable of providing boiler protection from cold mixing system return water temperatures. If the boiler water temperature is cooler than the Boiler Minimum setting while the boiler is firing, the AFM reduces the output from the mixing device. This limits the amount of cool return water to the boiler and allows the boiler water temperature to recover.

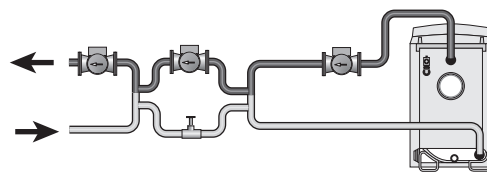
## MIXING DEVICES

### Mixing Device Selection

The AFM can supply a lower water temperature to part of the heating system by varying the speed of an injection pump or modulating a mixing valve. This selection is made under the Mixing item in the Adjust menu.

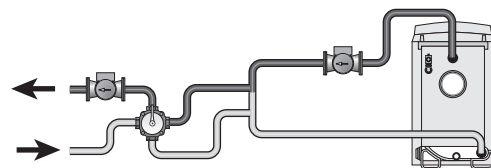
#### Variable Speed Injection

A standard wet rotor circulator is connected to the AFM on the Opn/Var terminal (28). The AFM increases or decreases the power output to the circulator when there is mix demand. The circulator speed varies to maintain the correct mixed supply water temperature at the mix supply sensor. For correct sizing and piping of the variable speed injection driven circulator, refer to the guidelines listed on the next page. A visual indication of the current variable speed output is displayed in the RDM in the form of a segmented bar graph. Two small indicators at the top of the graph indicate whether the output is increasing or decreasing.



#### Floating Action (24 V (ac) transformer required field supplied)

A floating action actuator motor is connected to the AFM on the Opn/Var and CIs terminals (28 and 29). The AFM pulses the actuator motor open or close to maintain the correct supply water temperature at the mix supply sensor when there is a mix demand. The mixing valve that the actuator can connect to can be either a 2-way, 3-way or 4-way valve. A visual indication as to whether the AFM is currently opening or closing the mixing valve is displayed in the RDM with the words Open and Close. Also, a visual indication of the current position of the valve is displayed in the RDM in the form of a segmented bar graph.

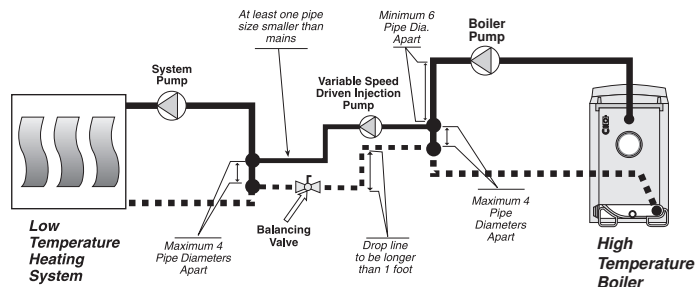


### Variable Speed Injection Piping Guidelines

There are a few simple piping details which should be considered, when mixing using a variable speed injection pump.

Variable speed injection systems require complete isolation between the boiler loop and system loop. For example, when the injection pump is turned off, there must be no heat transfer from the boiler loop to the system loop. In order to avoid this unwanted heat transfer, standard primary-secondary piping techniques are used as shown.

- This piping arrangement requires that the injection piping be at least one pipe diameter smaller than the piping of the boiler and system loops.
- There must be a maximum of 4 pipe diameters between the tees in the boiler and system loops in order to prevent ghost flow when the variable speed injection pump is off and either the boiler pump or system pump is on.
- There must be at least 6 pipe diameters of straight pipe on either side of the tees in order to prevent the momentum of water in the boiler and system loops from pushing flow through the injection loop.
- There should be a minimum 1 foot elevation drop to create a thermal trap in order to prevent convective heat transfer through the injection loop.

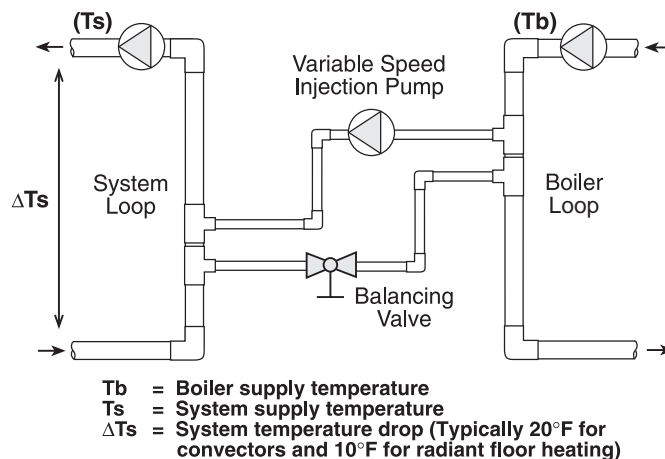


## Variable Speed Injection Design Procedure

### STEP 1

Determine the following design values:

- Boiler Supply Temperature (Tb)
- System Supply Temperature (Ts)
- System Flow Rate (US GPM) and System Loop Temperature Drop ( $\Delta T_s$ ). If one of these variables is unknown, use Equation 1 or 2 to calculate the other variable.



#### Equation 1

$$\text{System Flow Rate (US GPM)} = \frac{\text{Design Heating Load (Btu/hr)}}{500 \times \Delta T_s (^{\circ}\text{F})}$$

#### Equation 2

$$\Delta T_s (^{\circ}\text{F}) = \frac{\text{Design Heating Load (Btu/hr)}}{500 \times \text{System Flow Rate (US GPM)}}$$

#### Equation 3

$$\text{Design Injection Flow Rate (US GPM)} = \text{System Flow Rate (US GPM)} \times \text{Flow Ratio}$$

### STEP 2

Calculate  $T_b - T_s$ .

### STEP 3

Look up the required Flow Ratio on Chart 1.

### STEP 4

Calculate the design injection flow rate using Equation 3.

### STEP 5

Decide whether or not to include a balancing valve in the injection piping. A balancing (globe) valve allows adjustment when the injection pump is larger than needed. A balancing valve also provides the possibility of manual operation of the heating system by turning the injection pump fully on and adjusting the balancing valve to obtain the desired system supply water temperature.

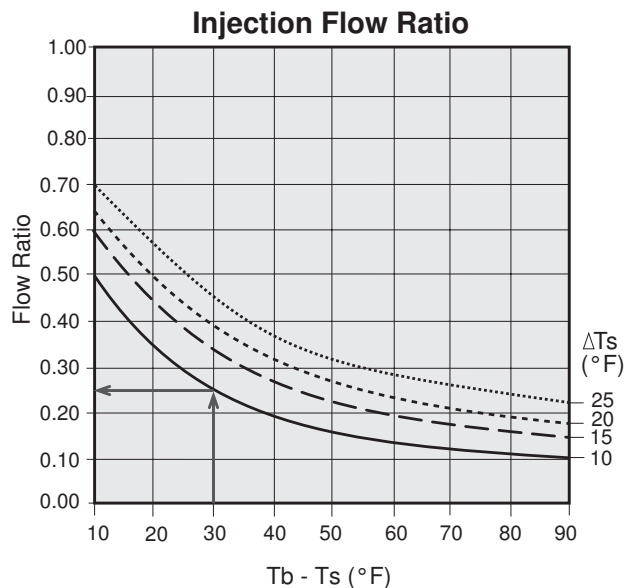


Chart 1

## STEP 6

The injection piping size and model of pump to install can now be looked up in the table shown below. Do not oversize the injection system. If the heating system is not able to get enough heat, the boiler's operating temperature will be increased automatically.

**Manufacturer Approved Pump Models**

Design Injection Flow Rate (US GPM)		Turns open of the	Nominal Pipe	Grundfos (F)			Taco				B&G			Armstrong	
Without Globe Valve	With Globe Valve	Globe Valve (%)	Diameter (inches)	15 - 42		26-64	003	007	0010	0012	NRF 9	NRF 22	NRF 33	Astro	
				2"	3"									30	50
—	1.5 - 2.0	20	0.5	√	√			√				√		√	
2.5	2	100	0.5				√								
4 - 5.5	3.0 - 4.5	100	0.5	√	√			√			√	√		√	
9 - 6.5	4 - 5.5	100	0.75				√				√				
9 - 10.5	7.5 - 8.5	100	0.75		√			√				√		√	
9	8	100	1								√				
14 - 15	12 - 13	100	1		√			√				√			
19	17	100	1.25												√
22 - 24	19 - 21	100	1.25			√			√				√		
26 - 28	—	100	1.5			√			√				√		
35 - 37	31 - 32	100	1.5							√					
33	30	100	2										√		
41 - 45	39 - 42	100	2							√					

\*Speed 2, \*\*Speed 3 (Brute)

This table assumes there are 5 feet of pipe, 4 elbows, and 4 branch tees of the listed diameter. These circulators have been tested and approved by the manufacturers for use with the tekmar variable speed electronics.

The drawings in this brochure are only concept drawings. The designer must determine which, if any, concept is best for his application and must ensure compliance with code requirements. Necessary auxiliary equipment and safety devices must be added.

## Example

**STEP 1**  $T_b = 160^{\circ}\text{F}$

$T_s = 130^{\circ}\text{F}$

$\Delta T_s = 10^{\circ}\text{F}$  (radiant floor heating)

System Flow Rate = 15 GPM

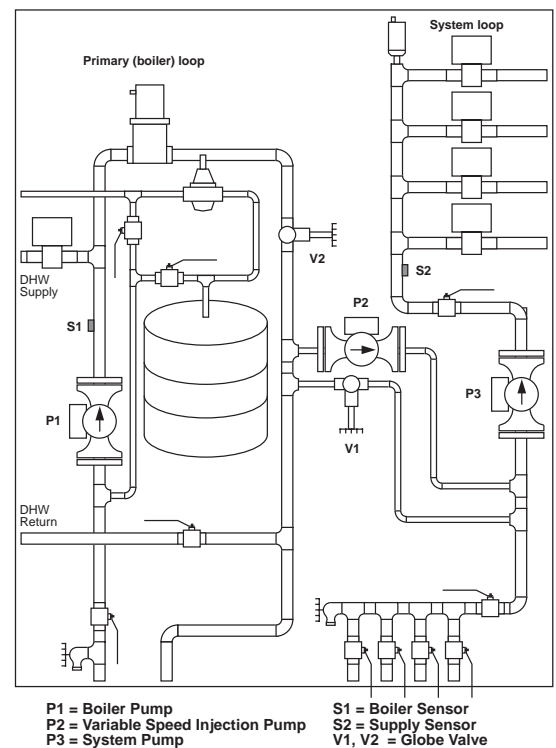
**STEP 2**  $T_b - T_s = 30^{\circ}\text{F}$

**STEP 3** Flow Ratio = 0.25 (see Chart 1)

**STEP 4** Injection Flow Rate = 3.75 GPM (15 GPM x 0.25)

**STEP 5** Use globe valve in order to control flow (recommended).

**STEP 6** Refer to the pump table. Look up the range of desired injection flow rate (3.0 - 4.5 GPM — use either of the checked pumps). Leave globe valve in the open position and use 0.5" pipe diameter.



## Section F: Pump Operation

### PUMP OPERATION

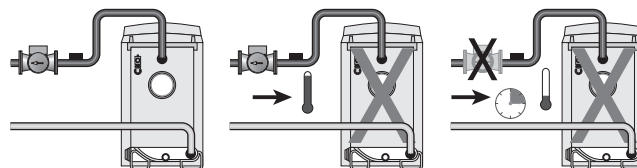
The AFM can power the Primary Pump, the Mix Pump, and the DHW Pump. The AFM can adjust the power level to the variable speed injection pump; however, the power for this pump is provided externally.

**Note:** Use isolation relay for pumps (DHW, Primary, Mixing) larger than 1/8 HP.

#### Primary Pump

The primary pump operates in the following conditions:

- A Boiler Demand is present and the AFM is not in WWSD.
- A Mix Demand is present and the AFM is not in WWSD.
- A DHW Demand is present and the AFM is set to DHW Mode 3.
- A Setpoint Demand is present and the AFM is set to Setpoint Mode 2.
- A Boiler Demand, Mixing Demand, DHW Demand (Mode 3), or Setpoint Demand (Mode 2) has been removed and a primary pump post purge has been set.



#### Mix Pump

The mix pump operates when a Mix Demand is present and the AFM is not in WWSD.

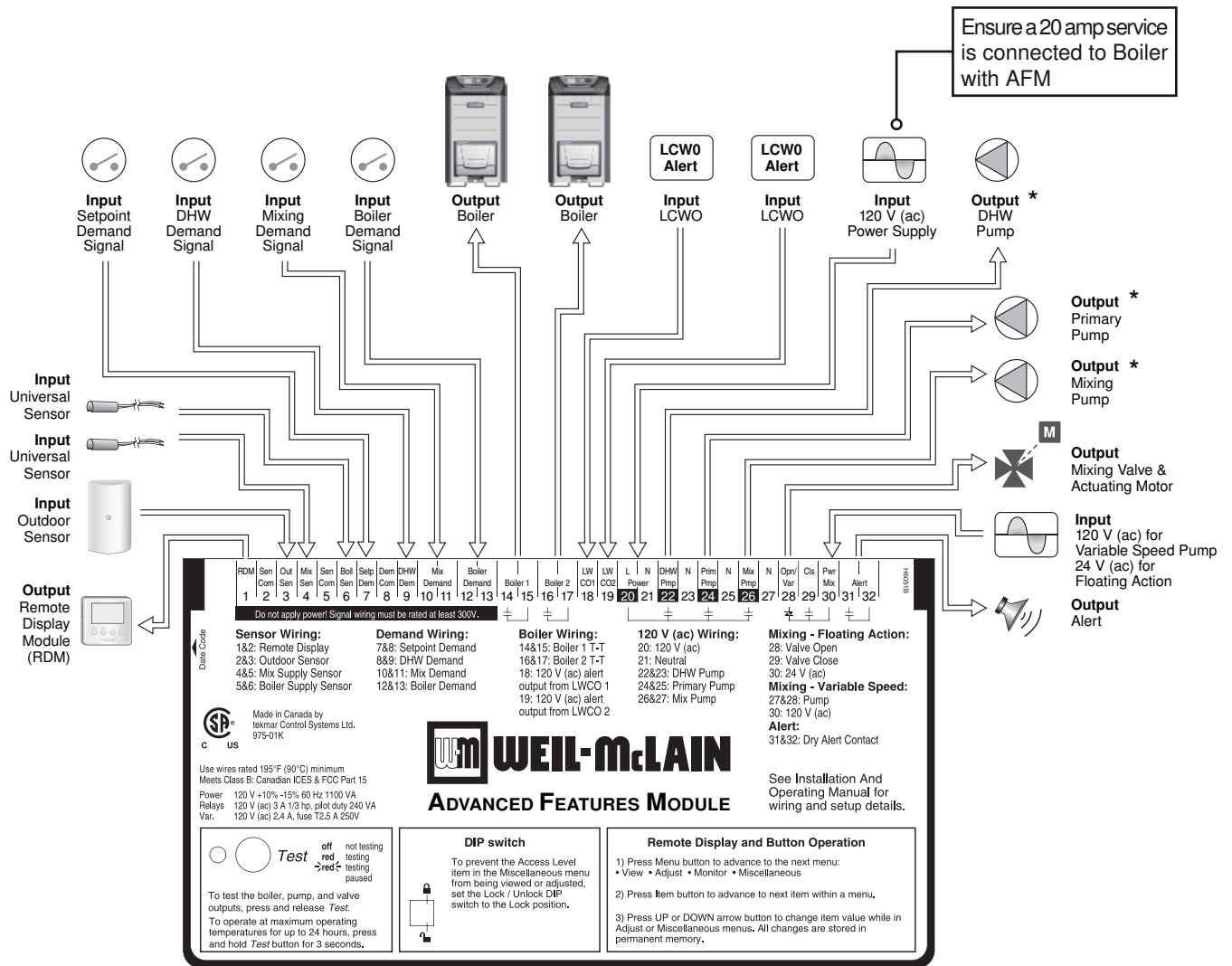
#### DHW Pump

The DHW Pump operates when a DHW Demand is present and the AFM is not in DHW Priority Override. The DHW Pump continues to operate after a DHW Demand to provide DHW post purge and DHW mix purge.

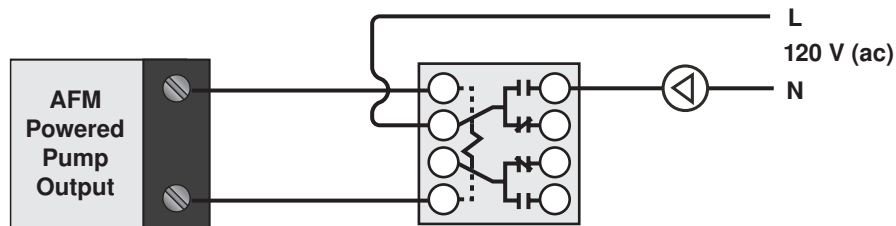
#### Variable Speed Injection Pump

The variable speed injection pump operates when the Mixing setting is set to Variable Speed, a Mix Demand is present and the boiler is operating above the Boiler Minimum setting.

## Advanced Features Module (AFM) Inputs and Outputs

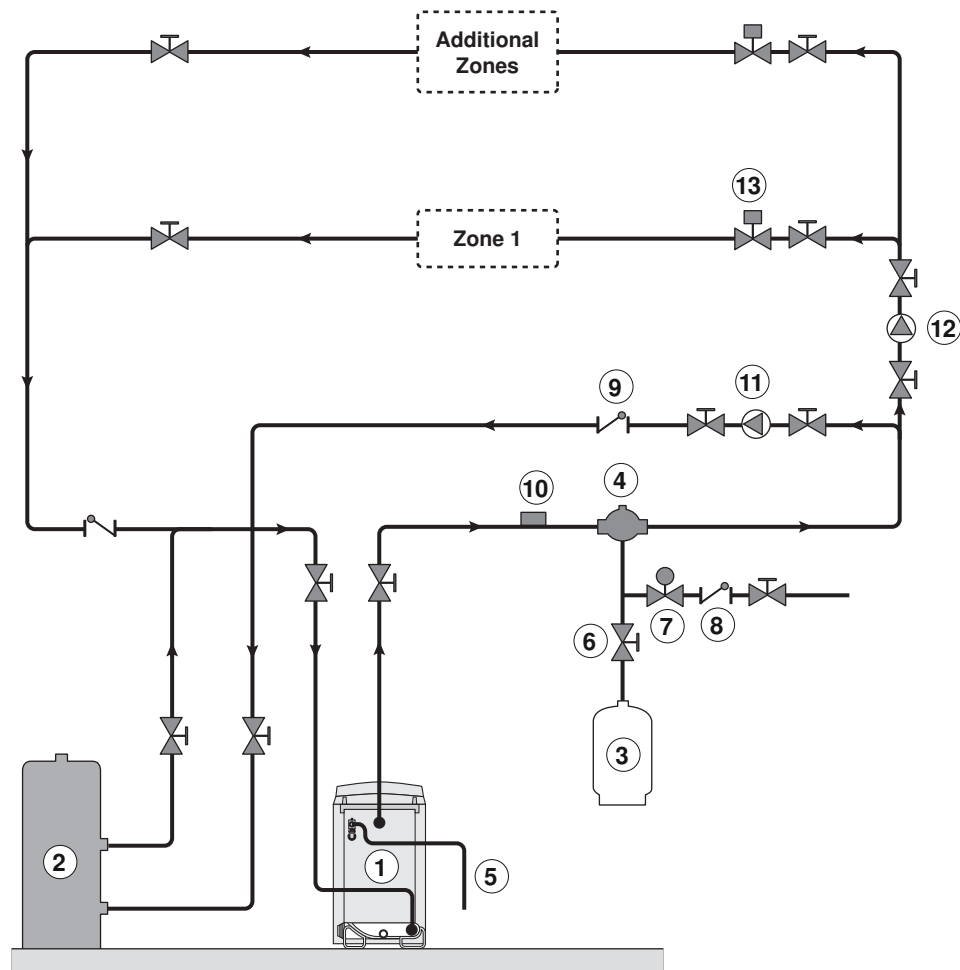


**\*Note:** Use isolation relay for pumps (DHW, Primary and Mixing) larger than 1/8 hp.





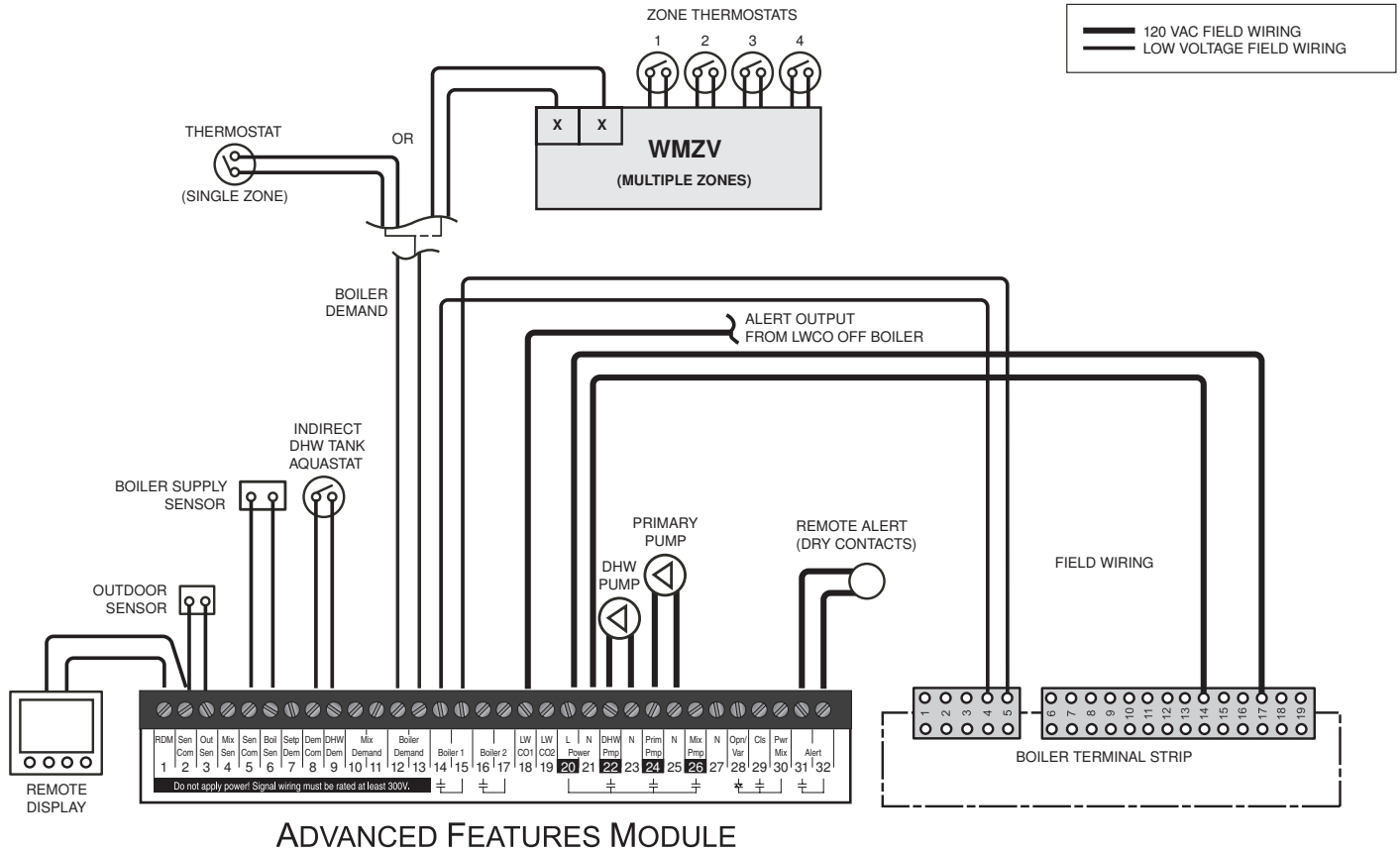
A single Ultra Oil boiler provides outdoor reset to space heating zones. The Plus indirect domestic hot water tank is heated when signaled by the tank aquastat. In multiple zone systems, a WMZV zone valve controller can be used to operate the zone valves. **For system temperatures of 140°F or higher.**



### Legend

- |   |                                     |  |
|---|-------------------------------------|--|
| 1 Ultra Oil boiler                      | 6 Isolation valve                   | 10 Boiler Supply Sensor                  |
| 2 Plus indirect domestic hot water tank | 7 Pressure reducing valve           | 11 Indirect domestic hot water tank pump |
| 3 Diaphragm type expansion tank         | 8 Check valve or backflow preventer | 12 Primary pump                          |
| 4 Air separator with automatic air vent | 9 Flow / check valve                | 13 Zone valve                            |
| 5 Relief valve and discharge piping     |                                     |  |





### Required Adjust menu settings:

**MIXING = OFF**

**BOILER 1 = AUTO**

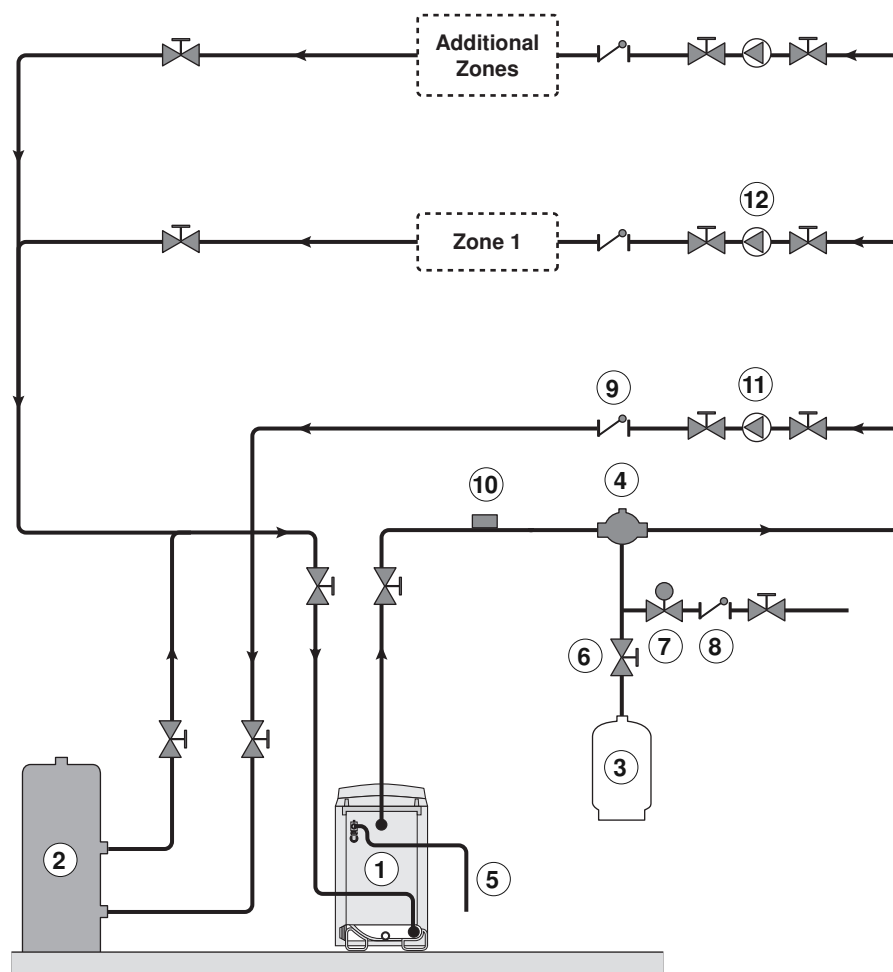
**BOILER 2 = OFF**

**DHW MODE = 1 OR 2**

**PURGE = OFF**

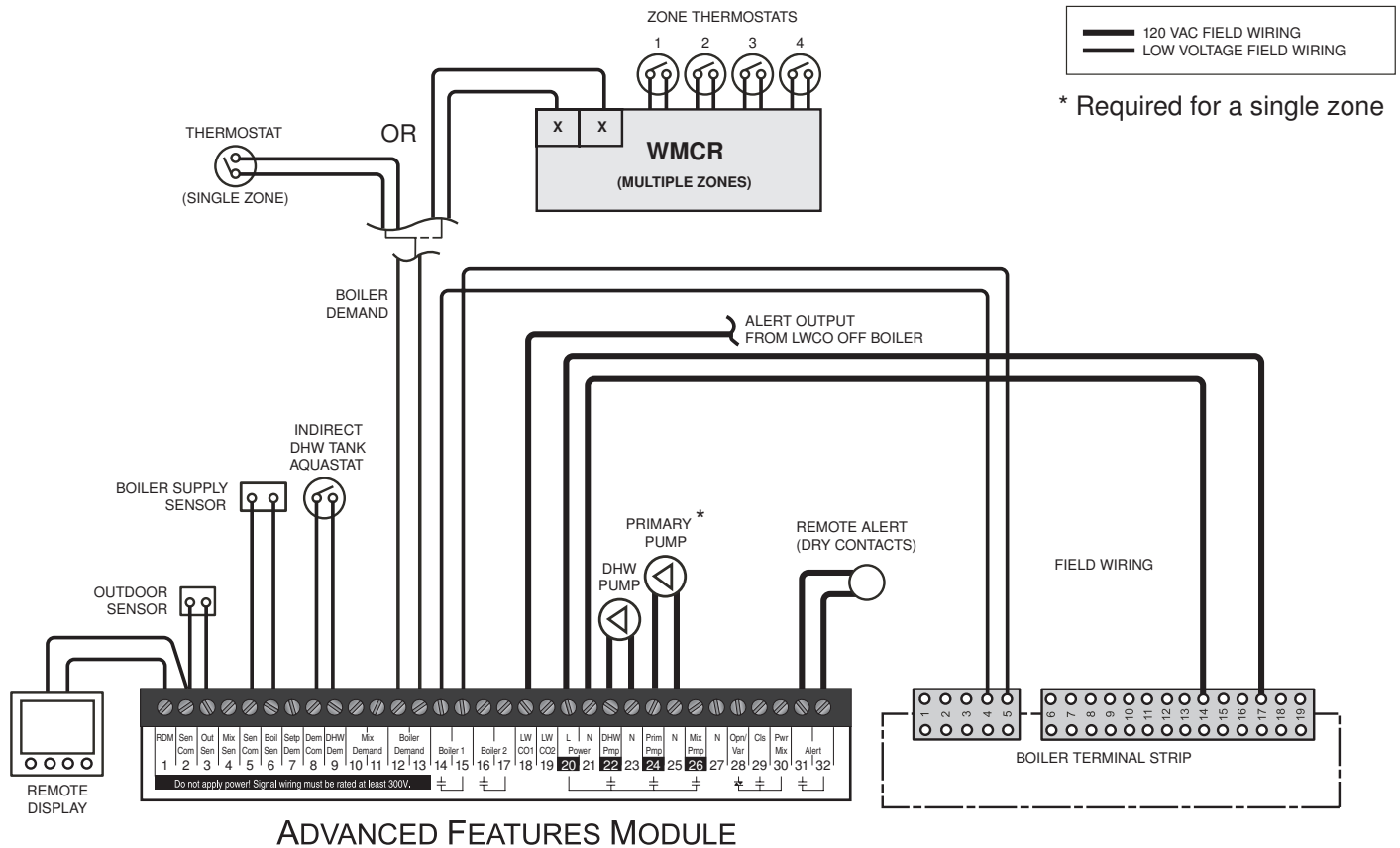


A single Ultra Oil boiler provides outdoor reset to space heating zones. The Plus indirect domestic hot water tank is heated when signaled by the tank aquastat. If there is a single space heating zone, only the primary pump is required. In multiple zone systems, a WMCR zone circulator controller can be used to operate the zone pumps. **For system temperatures of 140°F or higher.**



### Legend

- |   |                                     |  |
|---|-------------------------------------|--|
| 1 Ultra Oil boiler                      | 5 Relief valve and discharge piping | 9 Flow / check valve                     |
| 2 Plus indirect domestic hot water tank | 6 Isolation valve                   | 10 Boiler Supply Sensor                  |
| 3 Diaphragm type expansion tank         | 7 Pressure reducing valve           | 11 Indirect domestic hot water tank pump |
| 4 Air separator with automatic air vent | 8 Check valve or backflow preventer | 12 Primary or Zone pump                  |



### Required Adjust menu settings:

**MIXING = OFF**

**BOILER 1 = AUTO**

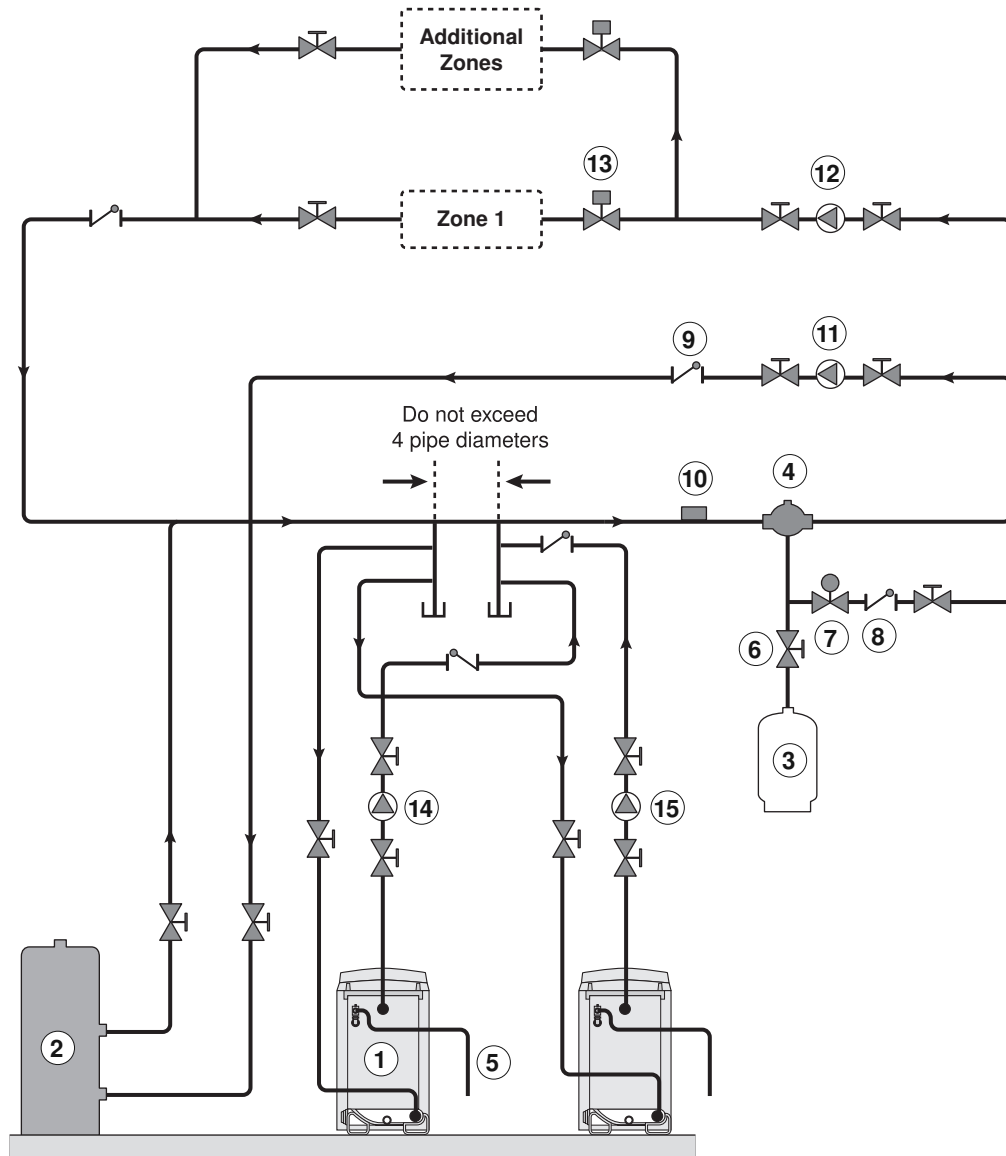
**BOILER 2 = OFF**

**DHW MODE = 1 OR 2**

**PURGE = OPTIONAL**

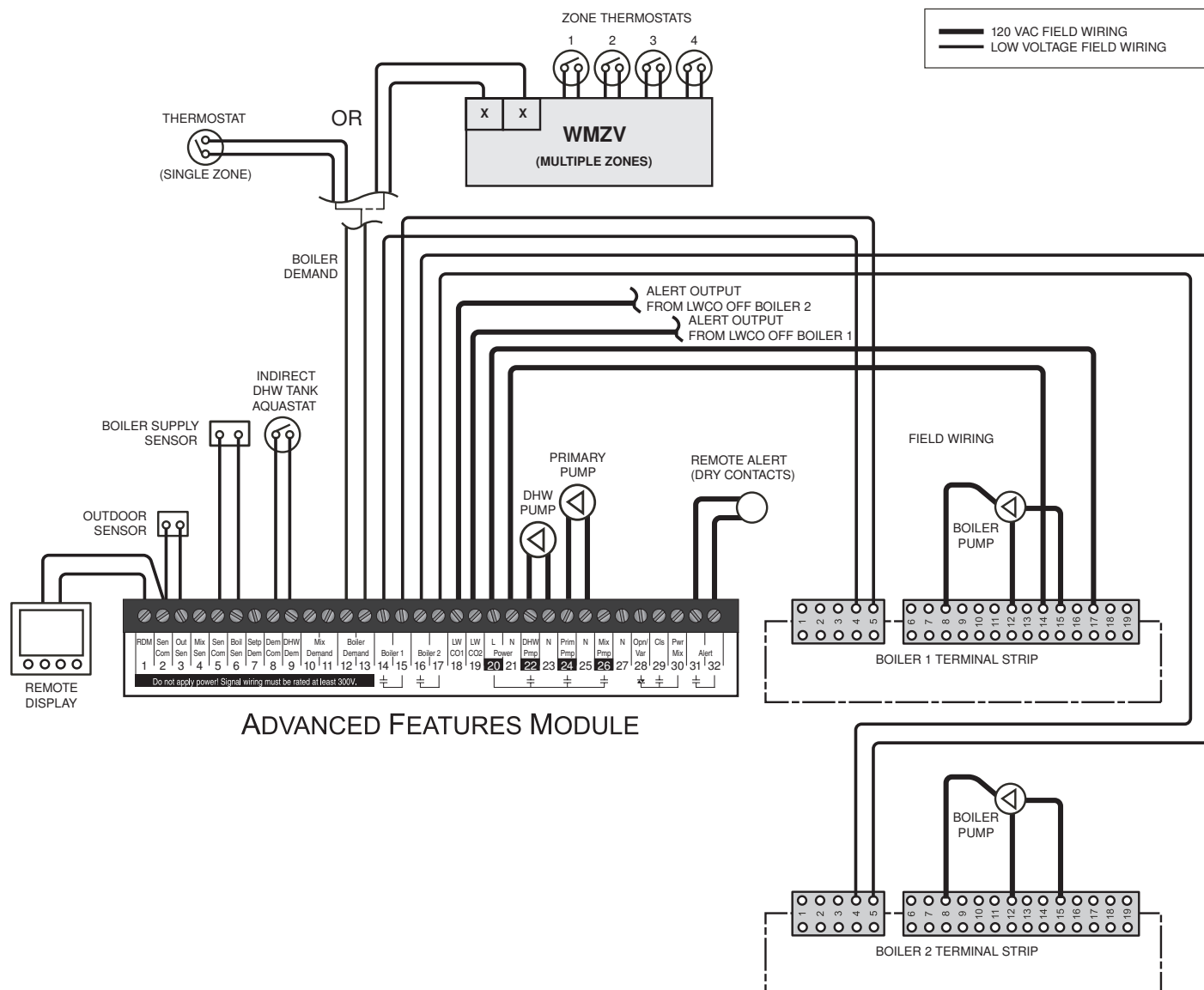


Two Ultra Oil boilers are staged and rotated to provide outdoor reset to space heating zones. The Plus indirect domestic hot water tank is heated when signaled by the tank aquastat. The two boilers are piped using the easy-fit manifold. The boiler pump required by each boiler is powered by the boiler aquastat. In multiple zone systems, a WMZV zone valve controller can be used to operate the zone valves. **For system temperatures of 140°F or higher.**



### Legend

- |   |                                     |  |
|---|-------------------------------------|--|
| 1 Ultra Oil boiler                      | 6 Isolation valve                   | 11 Indirect domestic hot water tank pump |
| 2 Plus indirect domestic hot water tank | 7 Pressure reducing valve           | 12 Primary Pump                          |
| 3 Diaphragm type expansion tank         | 8 Check valve or backflow preventer | 13 Zone valve                            |
| 4 Air separator with automatic air vent | 9 Flow / check valve                | 14 Boiler 1 Pump                         |
| 5 Relief valve and discharge piping     | 10 Boiler Supply Sensor             | 15 Boiler 2 Pump                         |



### Required Adjust menu settings:

**MIXING = OFF**

**BOILER 1 = AUTO**

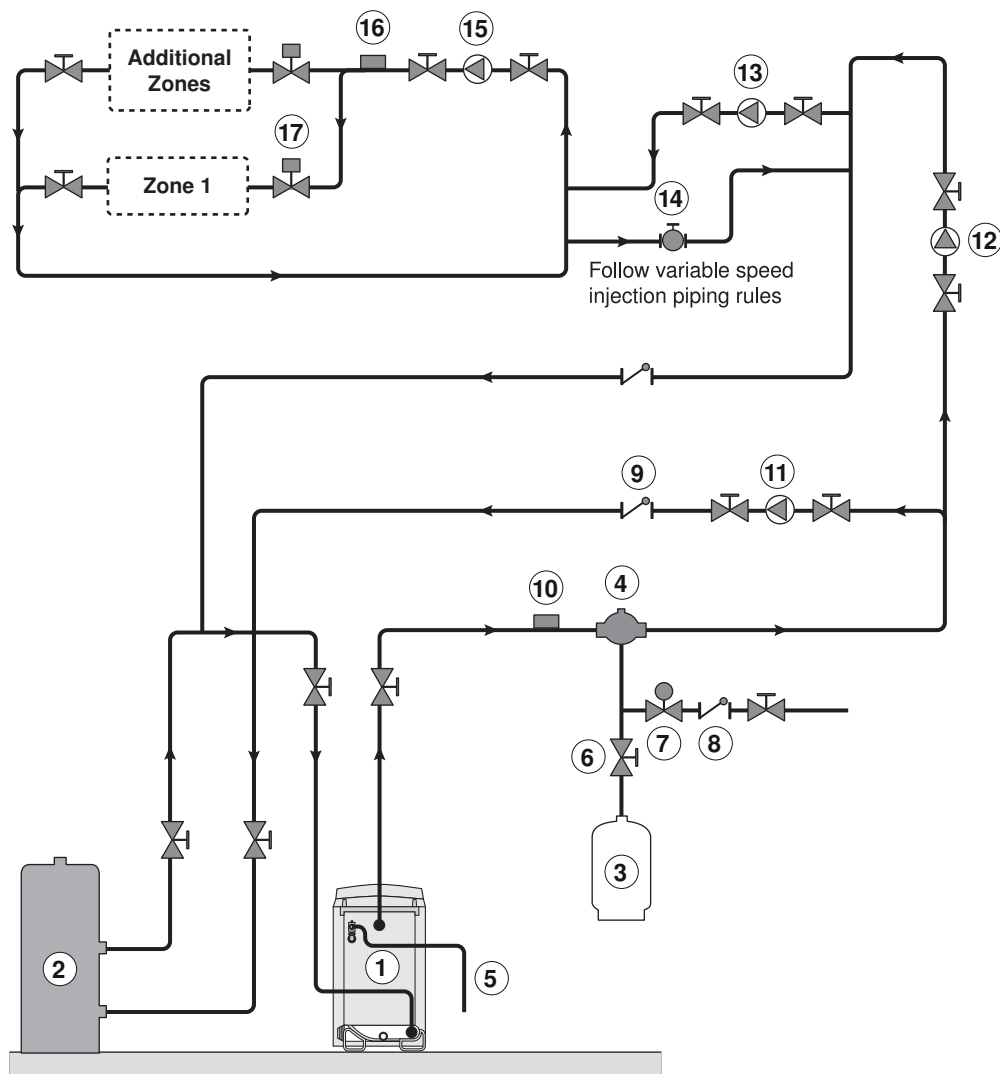
**BOILER 2 = AUTO**

**DHW MODE = 1 OR 2**

**PURGE = OFF**

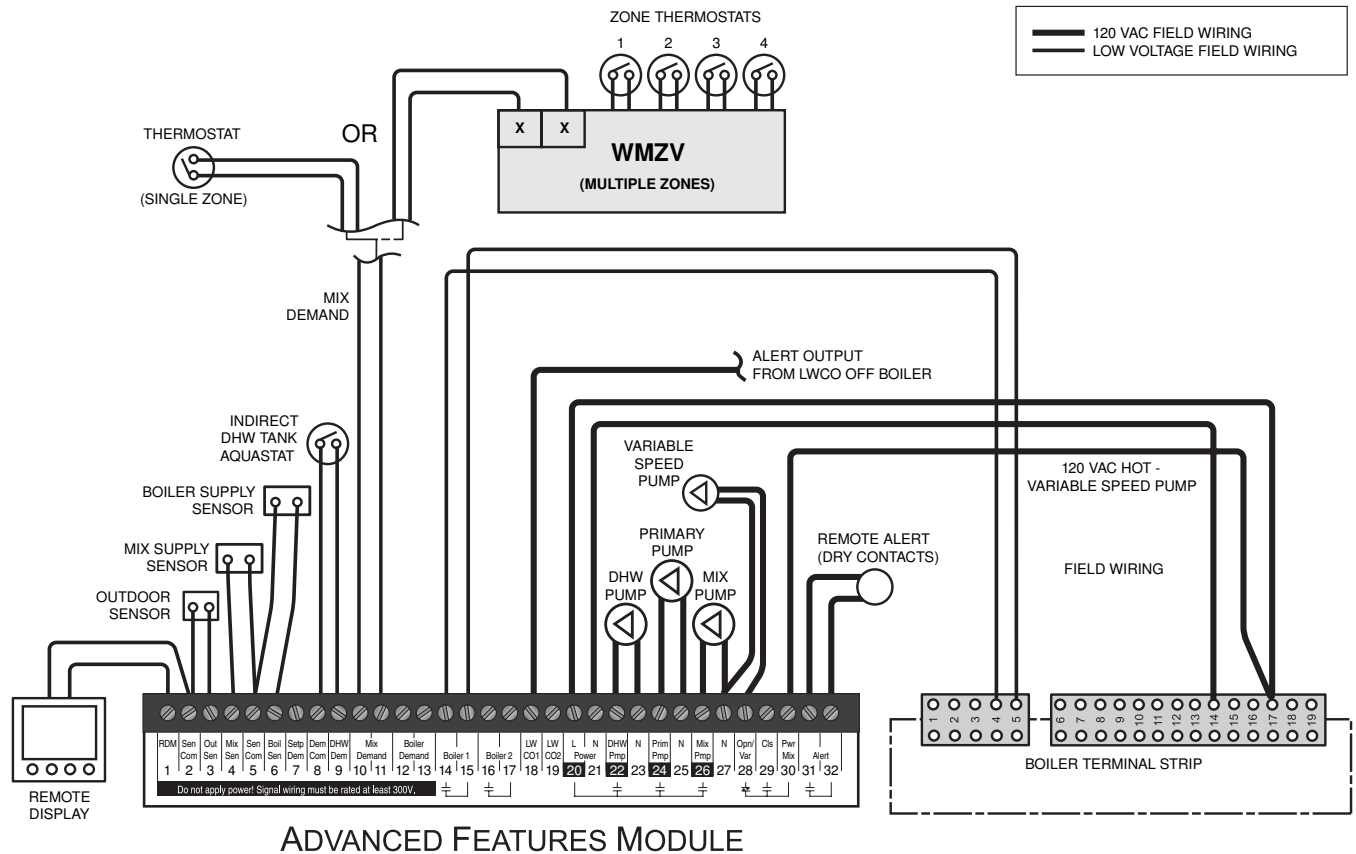


A single Ultra Oil boiler provides heat to a mix temperature water space heating system and a Plus indirect domestic hot water tank. The tank is heated when signaled by the tank aquastat. A variable speed injection pump is used to mix the boiler water temperature down to a mixed water temperature for space heating. The mix water temperature is adjusted according to outdoor reset. In multiple zone systems, a WMZV zone valve controller can be used to operate the zone valves.



### Legend

- |   |  |                                   |
|---|--|-----------------------------------|
| 1 Ultra Oil boiler                      | 7 Pressure reducing valve                | 13 Variable speed injection pump  |
| 2 Plus indirect domestic hot water tank | 8 Check valve or backflow preventer      | 14 Balancing valve or globe valve |
| 3 Diaphragm type expansion tank         | 9 Flow / check valve                     | 15 Mix system pump                |
| 4 Air separator with automatic air vent | 10 Boiler Supply Sensor                  | 16 Mix supply sensor              |
| 5 Relief valve and discharge piping     | 11 Indirect domestic hot water tank pump | 17 Zone valve                     |
| 6 Isolation valve                       | 12 Primary pump                          |                                   |



### Required Adjust menu settings:

**MIXING = VAR**

**BOILER 1 = AUTO**

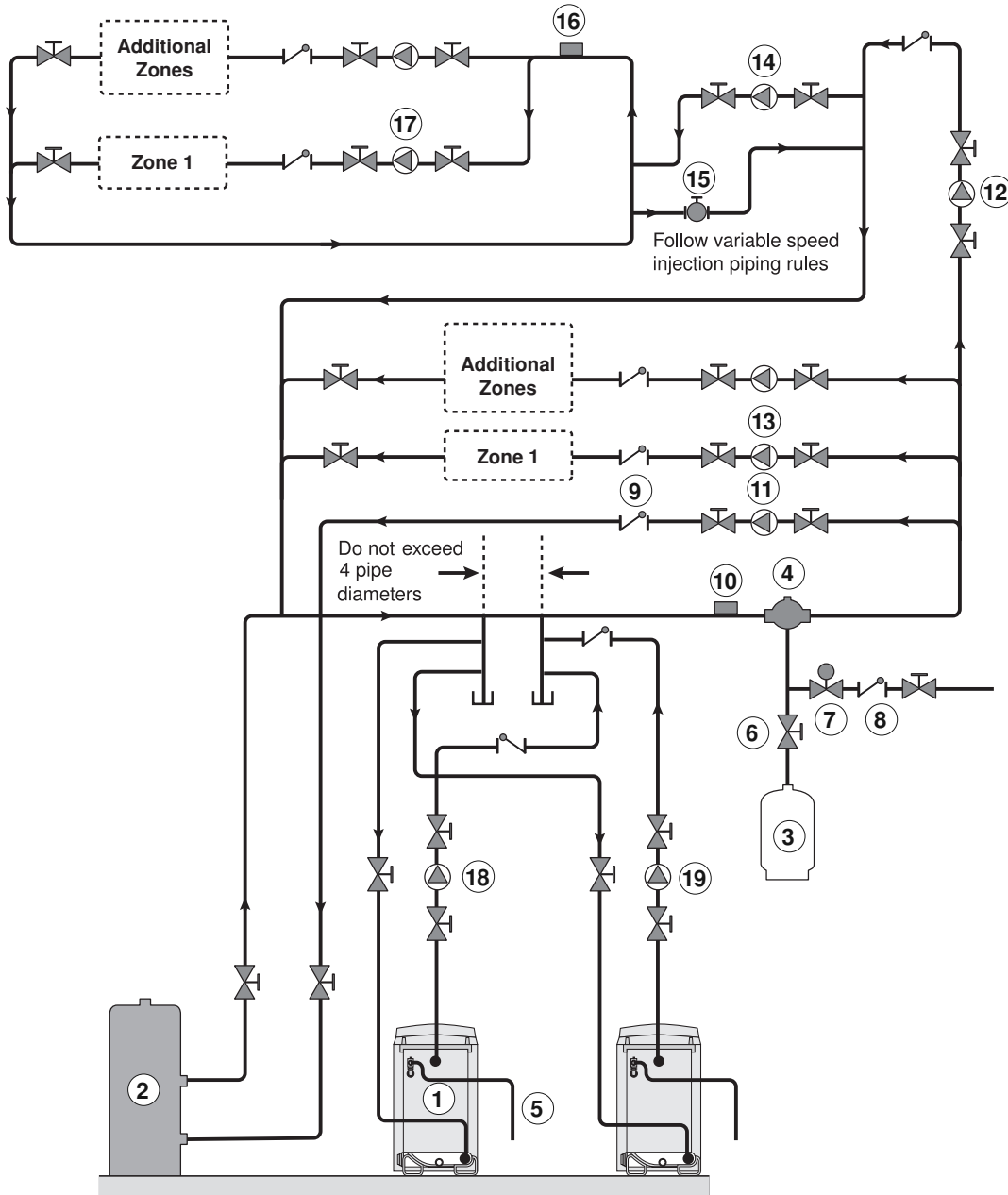
**BOILER 2 = OFF**

**DHW MODE = 1 OR 2**

**PURGE = OPTIONAL**



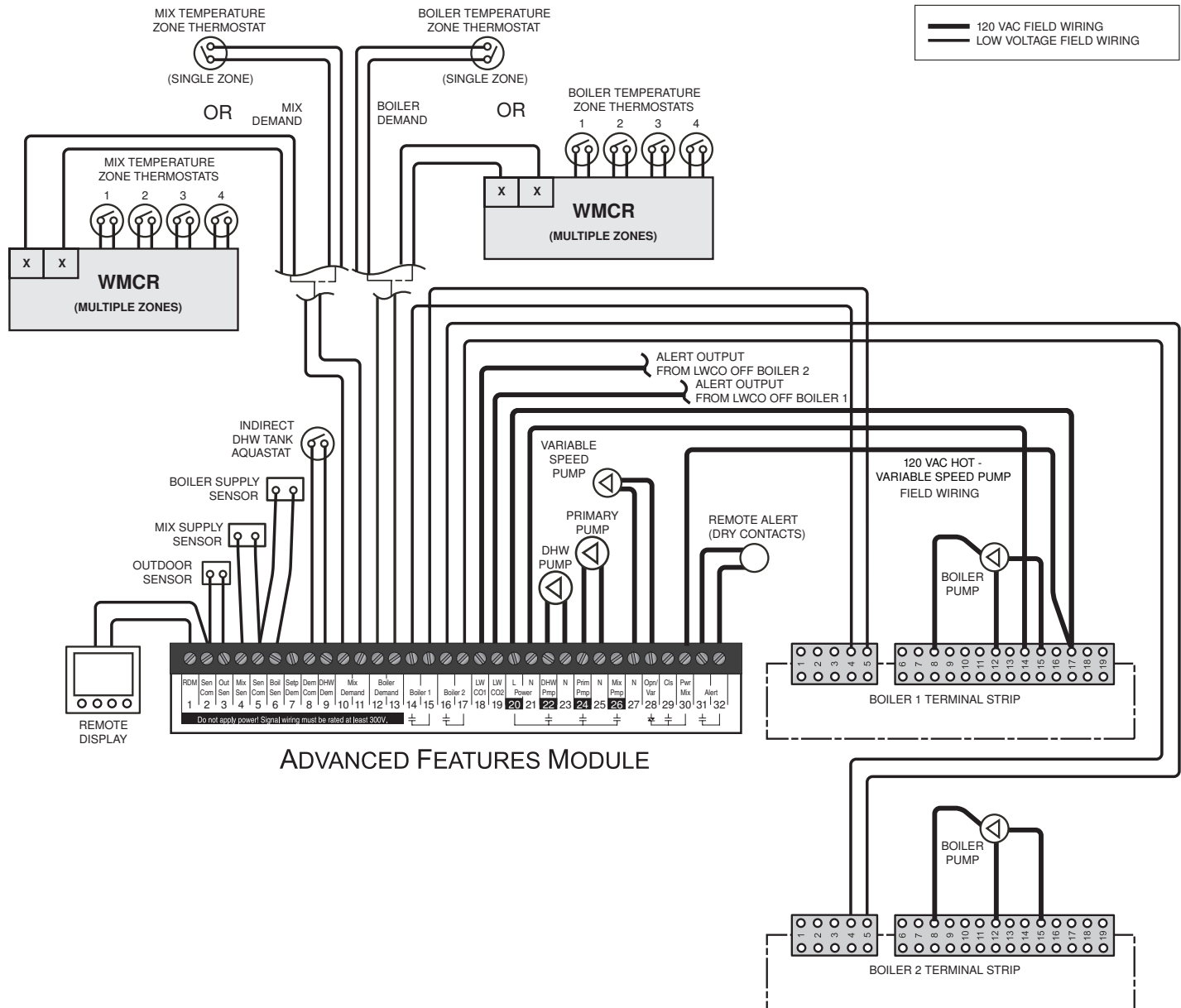
Two Ultra Oil boilers are staged and rotated to provide outdoor reset to boiler and mix water temperature space heating zones. The Plus indirect domestic hot water tank is heated when signaled by the tank aquastat. The two boilers are piped using the easy-fit manifold. The boiler pump required by each boiler is powered by the boiler aquastat. In multiple zone systems, a WMCR zone circulator controller can be used to operate the zone pumps. A variable speed injection pump is used to mix the boiler water temperature down to a mixed water temperature for space heating. The mix water temperature is adjusted according to outdoor reset.



### Legend

- |   |  |                                   |
|---|--|-----------------------------------|
| 1 Ultra Oil boiler                      | 8 Check valve or backflow preventer      | 14 Variable speed injection pump  |
| 2 Plus indirect domestic hot water tank | 9 Flow / check valve                     | 15 Balancing valve or globe valve |
| 3 Diaphragm type expansion tank         | 10 Boiler Supply Sensor                  | 16 Mix supply sensor              |
| 4 Air separator with automatic air vent | 11 Indirect domestic hot water tank pump | 17 Mix temperature zone pump      |
| 5 Relief valve and discharge piping     | 12 Primary pump                          | 18 Boiler 1 Pump                  |
| 6 Isolation valve                       | 13 Boiler temperature zone pump          | 19 Boiler 2 Pump                  |
| 7 Pressure reducing valve               |  |                                   |





### Required Adjust menu settings:

**MIXING = VAR**

**BOILER 1 = AUTO**

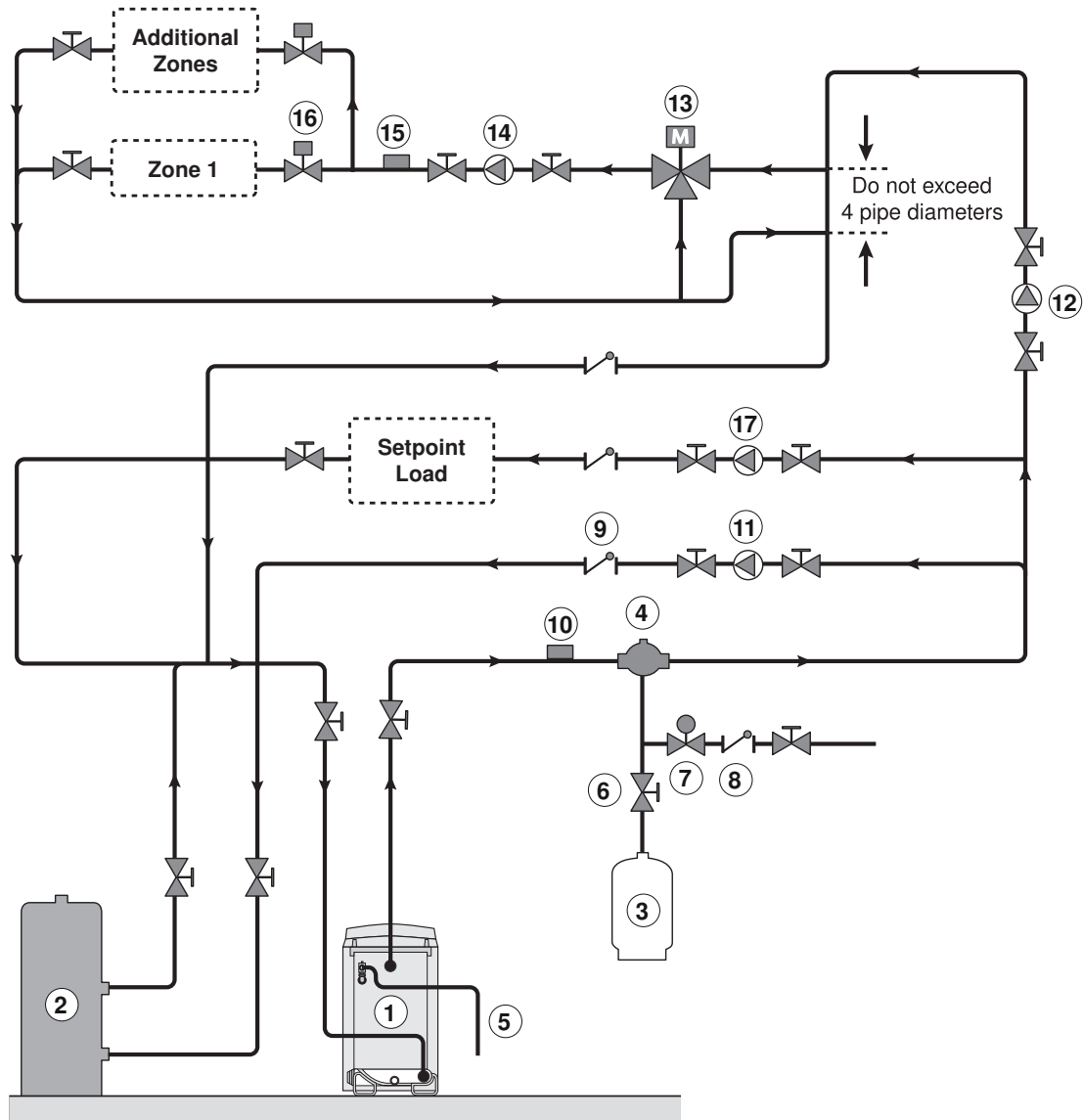
**BOILER 2 = AUTO**

**DHW MODE = 1 OR 2**

**PURGE = OPTIONAL**

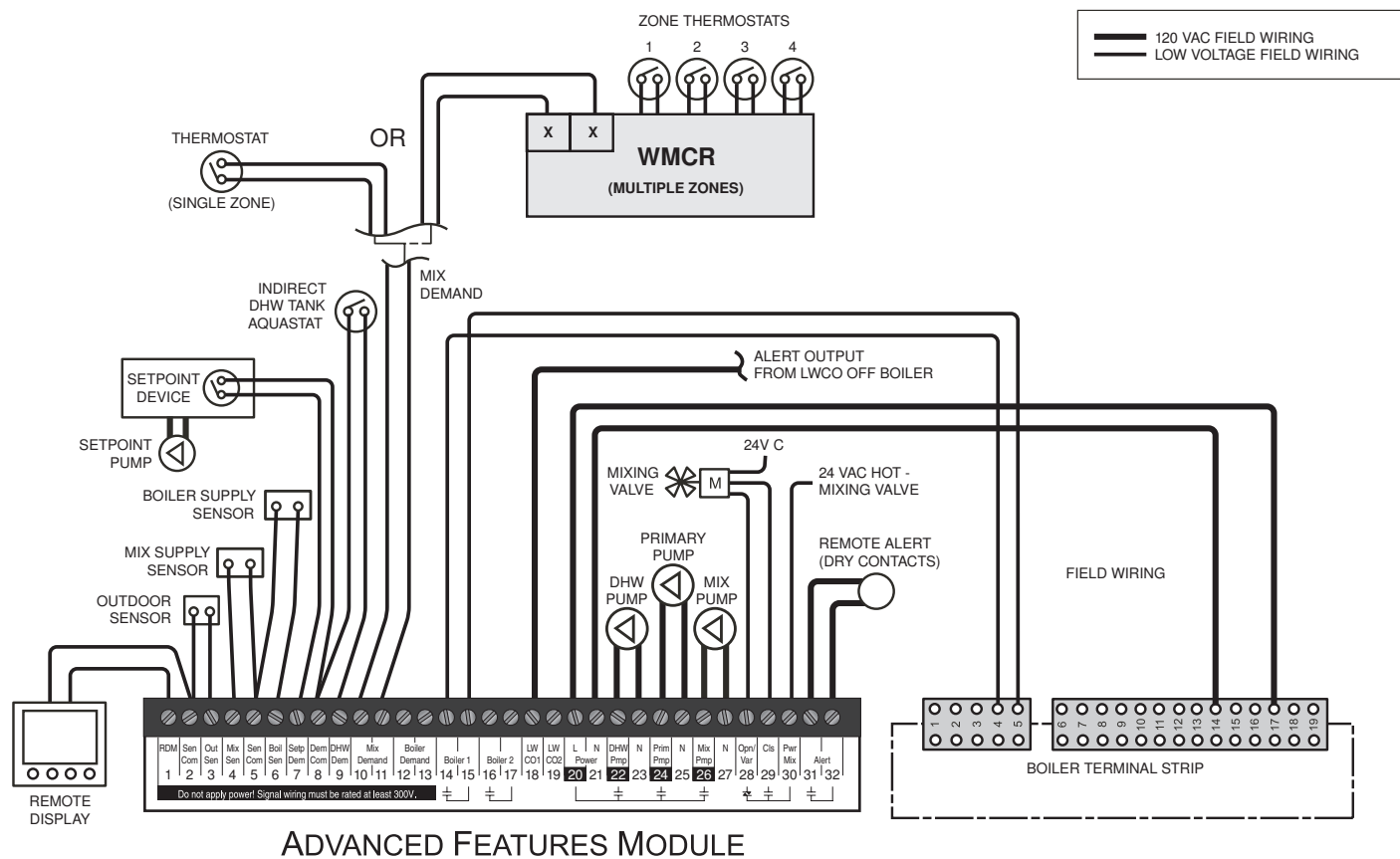


A single Ultra Oil boiler provides heat to a mix temperature water space heating system, a setpoint load, and a Plus indirect domestic hot water tank. The tank is heated when signaled by the tank aquastat. The setpoint load is heated at the setpoint temperature when a setpoint demand signal is provided. A 3-way valve and actuating motor is used to mix the boiler water temperature down to a mixed water temperature for space heating. The mix water temperature is adjusted according to outdoor reset. In multiple zone systems, a WMZV zone valve controller can be used to operate the zone valves.



### Legend

- |   |  |                                    |
|---|--|------------------------------------|
| 1 Ultra Oil boiler                      | 7 Pressure reducing valve                | 13 3-way valve and actuating motor |
| 2 Plus indirect domestic hot water tank | 8 Check valve or backflow preventer      | 14 Mix system pump                 |
| 3 Diaphragm type expansion tank         | 9 Flow / check valve                     | 15 Mix supply sensor               |
| 4 Air separator with automatic air vent | 10 Boiler Supply Sensor                  | 16 Mix temperature zone valve      |
| 5 Relief valve and discharge piping     | 11 Indirect domestic hot water tank pump | 17 Setpoint load pump              |
| 6 Isolation valve                       | 12 Primary pump                          |                                    |



**Note:** Required 24 V (ac) transformer is field supplied.

### Required Adjust menu settings:

**MIXING = FLOT**

**BOILER 1 = AUTO**

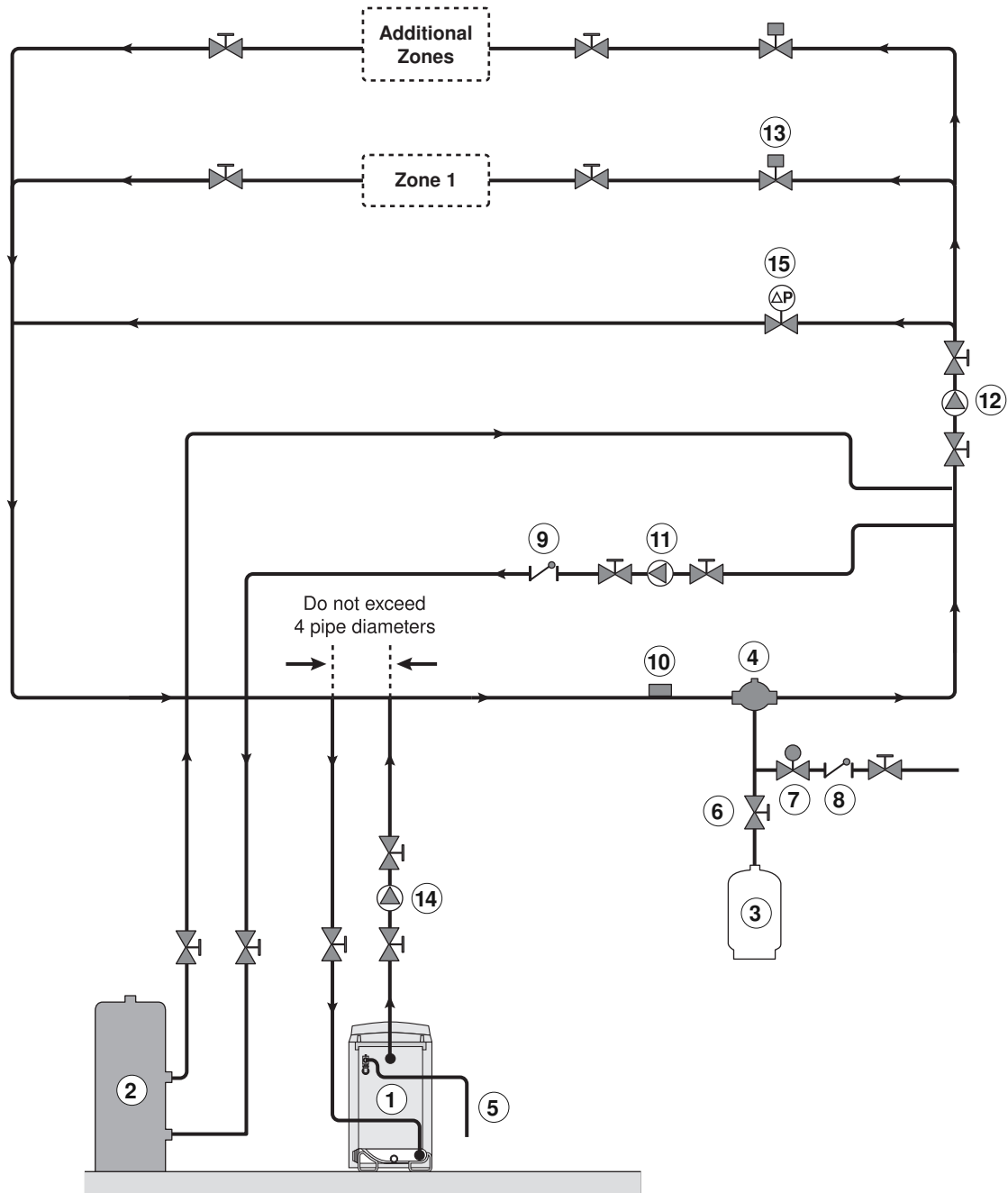
**BOILER 2 = OFF**

**DHW MODE = 1 OR 2**

**SETPPOINT MODE = 1**

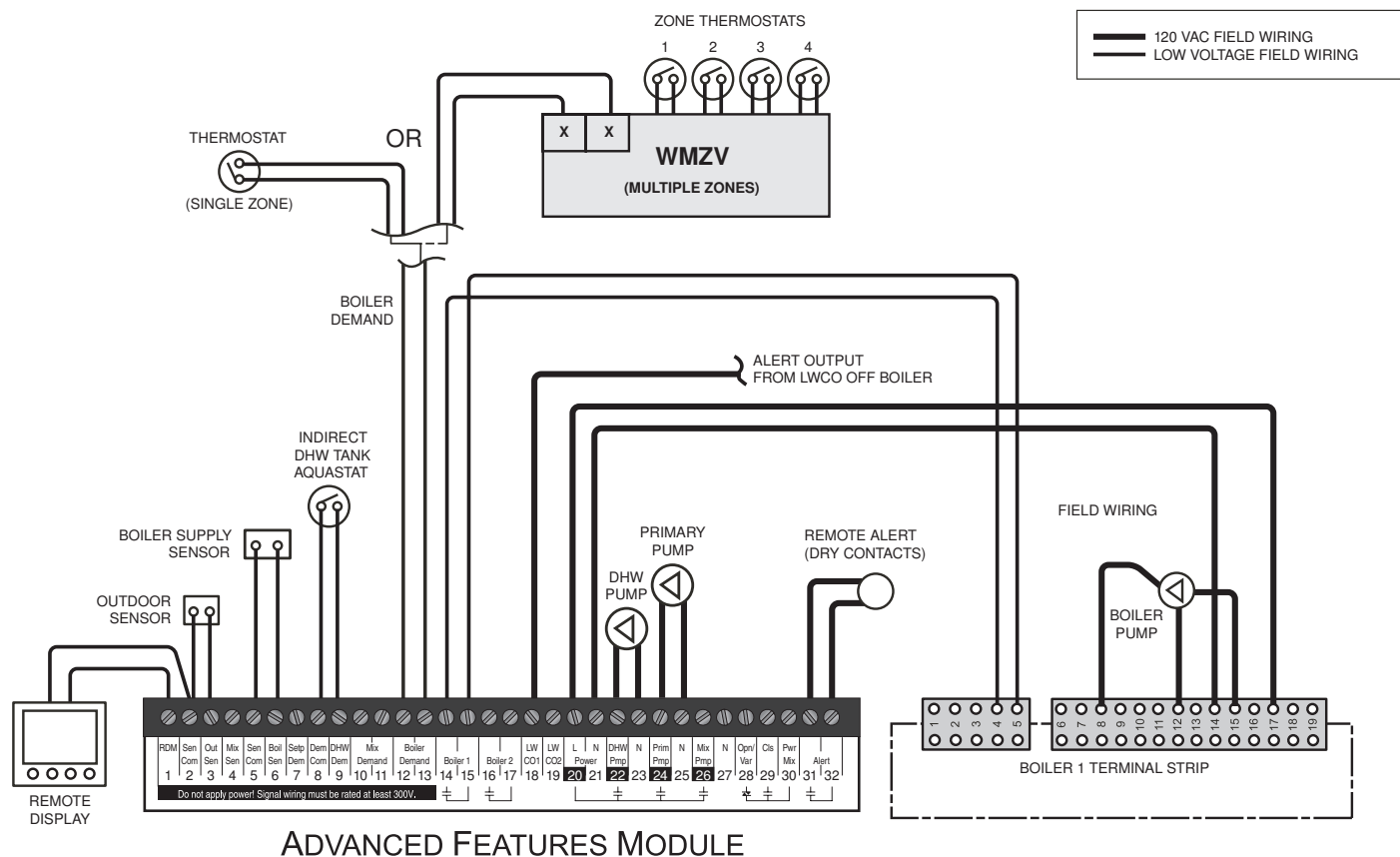


A single Ultra Oil boiler provides outdoor reset to space heating zones. The Plus indirect domestic hot water tank is heated when signaled by the tank aquastat. The boiler is piped in primary-secondary to the heating loop. In multiple zone systems, a WMZV zone valve controller can be used to operate the zone valves. **For system temperatures of 140° F or higher.**



### Legend

- |   |                                     |  |
|---|-------------------------------------|--|
| 1 Ultra Oil boiler                      | 6 Isolation valve                   | 11 Indirect domestic hot water tank pump |
| 2 Plus indirect domestic hot water tank | 7 Pressure reducing valve           | 12 Primary pump                          |
| 3 Diaphragm type expansion tank         | 8 Check valve or backflow preventer | 13 Zone valve                            |
| 4 Air separator with automatic air vent | 9 Flow / check valve                | 14 Boiler pump                           |
| 5 Relief valve and discharge piping     | 10 Boiler Supply Sensor             | 15 Pressure By-pass Valve                |



### Required Adjust menu settings:

MIXING = OFF

BOILER 1 = AUTO

BOILER 2 = OFF

DHW MODE = 3

PURGE = OPTIONAL

## Installation

### AFM CONTENTS

- |                                      |   |
|--------------------------------------|---|
| 1) Advanced Feature Module           | 7) DIN Rail                             |
| 2) Remote Display Module             | 8) Two Mounting Screws                  |
| 3) Installation and Operation Manual | 9) Wire labeled "Remote Display Module" |
| 4) Outdoor Sensor                    | 10) Wire labeled "Boiler 1 TT"          |
| 5) Two Universal Sensors             | 11) Wire labeled "AFM 120 V (ac)"       |
| 6) Screwdriver                       |   |

### WIRING INSTRUCTIONS

#### CAUTION

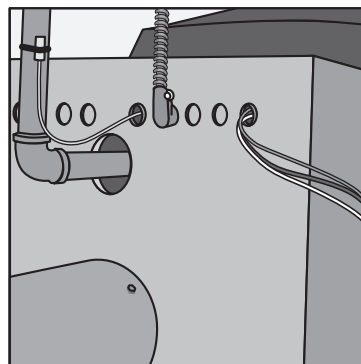
Improper installation and operation of this control could result in damage to the equipment and possibly even personal injury. It is your responsibility to ensure that this control is safely installed according to all applicable codes and standards. This electronic control is not intended for use as a primary limit control. Other controls that are intended and certified as safety limits must be placed into the control circuit.

#### WARNING

Wiring of the AFM requires handling high voltage wiring. Disconnect all power from the Ultra Oil boiler(s) before wiring. Only trained and qualified personnel should perform the installation.

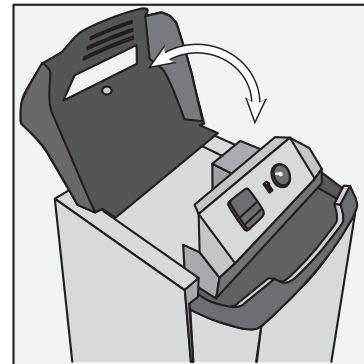
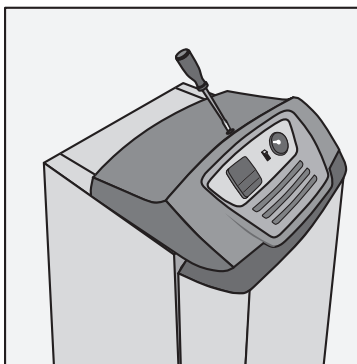
#### ROUGH-IN WIRING

- All wires are to be stripped to a length of 3/8" (9 mm) to ensure proper connection to the AFM.
- The AFM uses the same power supply as the Ultra Oil boiler. Ensure the Ultra Oil boiler is connected a clean power source with a 20 amp service to ensure proper operation.
- Use the provided 14 AWG wires labelled "120 V (ac)" from the Boiler Terminal strip to the AFM.
- Multi-strand 18 AWG wire is recommended for all other 120 V (ac) wiring due to its superior flexibility and ease of installation into the terminals.
- All field provided line voltage wiring must be sheathed in flexible or rigid metal conduit. Low voltage wiring may be run without conduit as long as grommets or anti-short bushings are used.

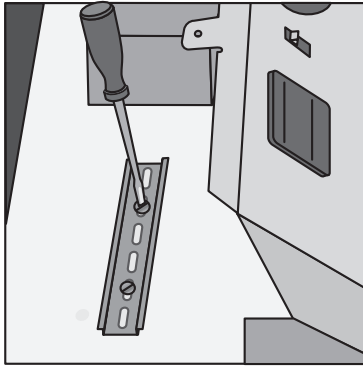


### STEP ONE MOUNTING THE ADVANCED FEATURES MODULE

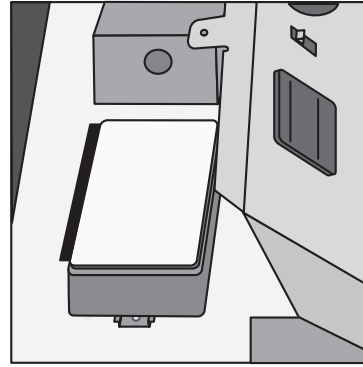
- A) Disconnect power from the Ultra Oil.
- B) Release Pod control cover by loosening the retainer screw in the top center of the cover. Swing the cover open to reveal the control compartment.



C) Install the DIN Rail using the two mounting screws.



D) The bottom side the AFM has a DIN rail slot and snap. Hook the slot along the DIN rail and pivot the AFM downwards. The DIN rail snap will “click” when the AFM is attached to the DIN rail.

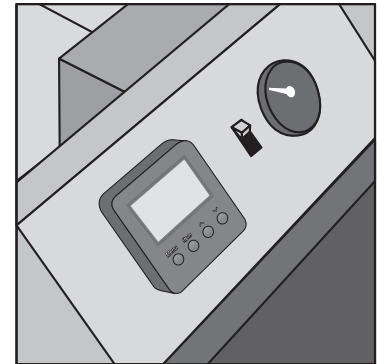
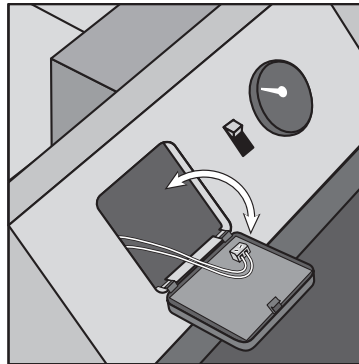
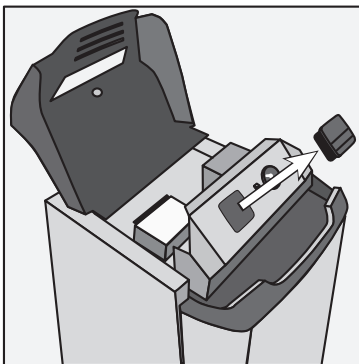


## STEP TWO ——— INSTALLING THE REMOTE DISPLAY MODULE ———

The Remote Display Module may be wall mounted or installed on the Ultra Oil boiler control panel.

### Control Panel Mounting

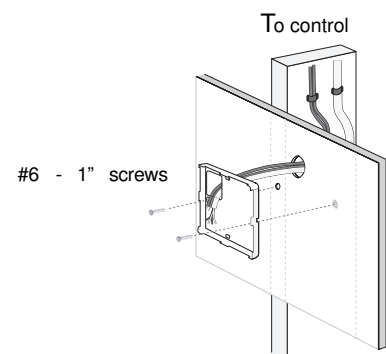
- A) Remove the Weil-McLain logo plate by pressing down on the top tab.
- B) Remove the RDM back cover and discard.
- C) Route wire harness labeled “Remote Display Module” through the control panel opening and connect the blue wire from AFM terminal 1 to RDM terminal 1, and the yellow wire from AFM terminal 2 to RDM terminal 2. **Note:** RDM connection to AFM is polarity sensitive.
- D) Install RDM by aligning the two bottom tabs with the notches in control panel opening. Pivot the top of RDM and push the top against the control panel until it snaps firmly in place.



### Wall Mounting

Use the back cover provided with the RDM.

- 1) Place a screwdriver or similar object into the small slot located in the top of the RDM. Push the screwdriver against the plastic tab, and pull the top of the front cover so that it pivots around the bottom edge of the RDM.
- 2) The base of the RDM should be securely installed in the desired location. Mount the RDM directly to the desired location using two #6-1” screws. The screws are inserted through the mounting holes and must be securely fastened to the desired location. If possible, at least one of the screws should enter a wall stud or similar surface.
- 3) Discard wire harness labeled “Remote Display Module”.
- 4) Run 18 AWG twisted pair or similar wire between the RDM and the control. Insert the wires through the hole provided in the back of the RDM enclosure and connect them to the Com and the AFM terminals. RDM can be mounted up to 500 ft. away from the AFM.

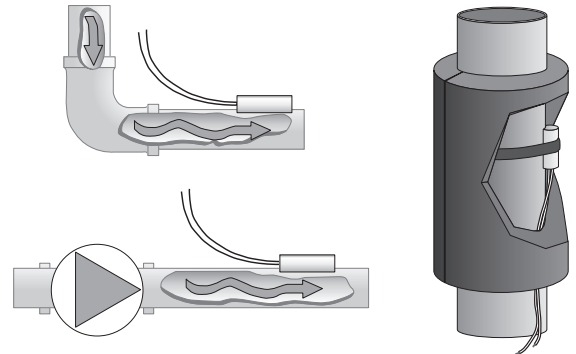


- 5) Route field wiring through one of the knockouts in the boiler back panel using grommets or anti-short bushings. Connect AFM terminal 1 to RDM terminal 1. Connect AFM terminal 2 to RDM Terminal 2.

**Note:** Do not apply power to the RDM. The RDM is to be wired directly to the control. The connection between the control and the RDM is polarity sensitive. The Com terminal of the RDM must be connected to the Com terminal of the control.

### STEP THREE — INSTALLING THE BOILER SENSOR

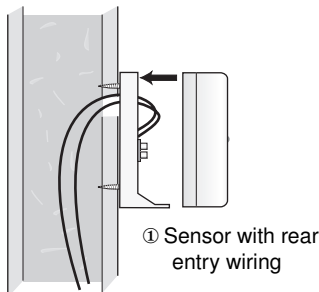
Connect one Universal Sensor to the boiler outlet pipe if using a single Ultra Oil boiler. In applications with two Ultra Oil boilers, the Universal Sensor must be located where the two boilers tie together into a common manifold or on a primary loop. The Universal Sensor should be located downstream of an elbow or a pump to ensure an average temperature reading. The Universal Sensor may be strapped onto copper pipe and insulated. For steel pipe, it is recommended to install a 3/8" (10 mm) temperature immersion well and mount the Universal Sensor into the well. Use 18 AWG or similar wire to connect the boiler sensor to terminals 5 and 6 on the AFM.



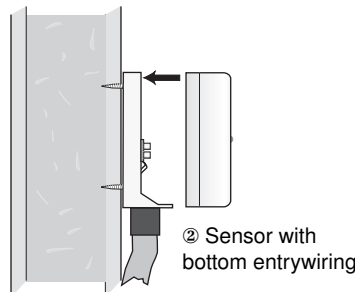
### STEP FOUR — INSTALLING THE OUTDOOR SENSOR

**Note:** The temperature sensor (thermistor) is built into the Outdoor Sensor enclosure.

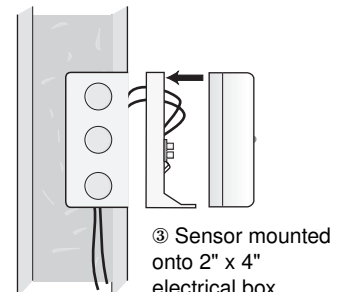
- A) Remove the screw and pull the front cover off the sensor enclosure.
- B) The Outdoor Sensor can either be mounted directly onto a wall or a 2" x 4" electrical box. When the Outdoor Sensor is wall mounted, the wiring should enter through the back or bottom of the enclosure. Do not mount the Outdoor Sensor with the conduit knockout facing upwards as rain could enter the enclosure and damage the sensor.



① Sensor with rear entry wiring

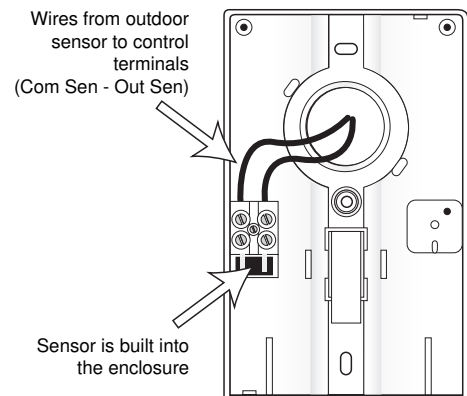


② Sensor with bottom entry wiring



③ Sensor mounted onto 2" x 4" electrical box

- C) In order to prevent heat transmitted through the wall from affecting the sensor reading, it may be necessary to install an insulating barrier behind the enclosure.
- D) The Outdoor Sensor should be mounted on a wall which best represents the heat load on the building (a northern wall for most buildings and a southern facing wall for buildings with large south facing glass areas). The Outdoor Sensor should not be exposed to heat sources such as ventilation or window openings.
- E) The Outdoor Sensor should be installed at an elevation above the ground that will prevent accidental damage or tampering.
- F) Connect 18 AWG or similar wire to the two terminals provided in the enclosure and run the wires from the Outdoor Sensor to the AFM terminals 2 and 3.



### IMPORTANT

Do not run the wires parallel to telephone or power cables. If the sensor wires are located in an area with strong sources of electromagnetic interference (EMI), shielded cable or twisted pair should be used or the wires can be run in a grounded metal conduit. If using shielded cable, the shield wire should be connected to terminal 2 on the AFM and not to earth ground.

- G) Replace the front cover of the sensor enclosure.



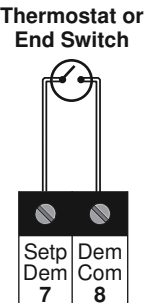
**STEP FIVE ————— INSTALLING THE MIX SENSOR —————**

If a mixing valve or a variable speed injection pump is installed, a Universal Sensor is required on the mixing system supply pipe. The Universal Sensor should be located downstream of an elbow or a pump to ensure an average temperature reading. The Universal Sensor may be strapped onto copper pipe and insulated. For steel pipe, it is recommended to install a 3/8" (10 mm) ID temperature immersion well and mount the Universal Sensor into the well. Use 18 AWG or similar wire to connect the mix sensor to terminals 4 and 5 on the AFM.

**STEP SIX ————— SETPOINT DEMAND —————**

*Warning*  
**Do not apply power!**

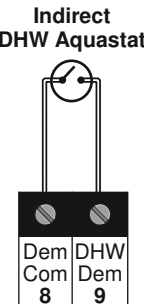
The Setpoint Demand on terminals 7 and 8 on the AFM can connect to a thermostat or a dry contact switch. A Setpoint Demand is created when there is a contact closure between terminals 7 and 8. It is recommended to use 18 AWG or similar wire.



**STEP SEVEN ————— DHW DEMAND —————**

*Warning*  
**Do not apply power!**

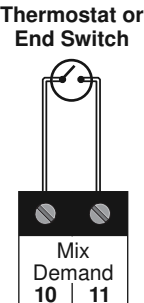
The DHW Demand on terminals 8 and 9 on the AFM can connect to a mechanical aquastat switch in an indirect domestic hot water tank. A DHW Demand is created when there is a contact closure between terminals 8 and 9. It is recommended to use 18 AWG or similar wire.



**STEP EIGHT ————— MIX DEMAND —————**

*Warning*  
**Do not apply power!**

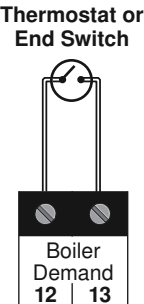
The Mix Demand on terminals 10 and 11 on the AFM can connect to a thermostat or a dry end switch regulating mix temperature zones. A Mix Demand is created when there is a contact closure between terminals 10 and 11. It is recommended to use 18 AWG or similar wire.



**STEP NINE ————— BOILER DEMAND —————**

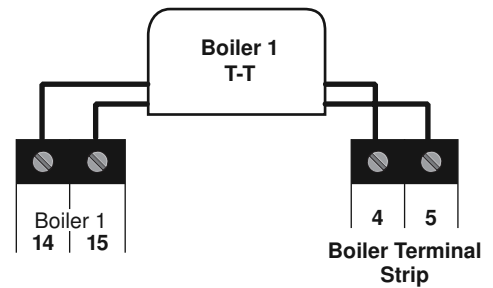
*Warning*  
**Do not apply power!**

The Boiler Demand on terminals 12 and 13 on the AFM can connect to a thermostat or a dry end switch regulating boiler temperature zones. A Boiler Demand is created when there is a contact closure between terminals 12 and 13. It is recommended to use 18 AWG or similar wire.



## STEP TEN ————— BOILER 1 —————

The wire labeled “Boiler 1 T-T” allows the AFM to turn the burner on and off. Connect the one black wire from terminal 14 on the AFM to terminal 4 on the Boiler Terminal Strip. Connect the other black wire from terminal 15 on the AFM to terminal 5 on the Boiler Terminal Strip.

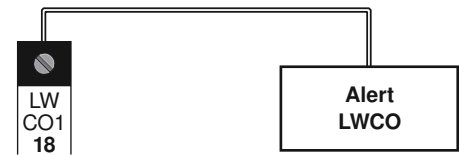


## STEP ELEVEN ————— BOILER 2 —————

If a second Ultra Oil is installed, use 18 AWG or similar wire to connect terminals 16 and 17 on the AFM to the second Ultra Oil field wiring terminals 4 and 5.

## STEP TWELVE ————— LOW WATER CUT OFF ON BOILER 1 —————

If a Low Water Cut Off (LWCO) is installed, connect a single 18 AWG or similar wire from terminal 18 on the AFM to the alarm output on the LWCO.

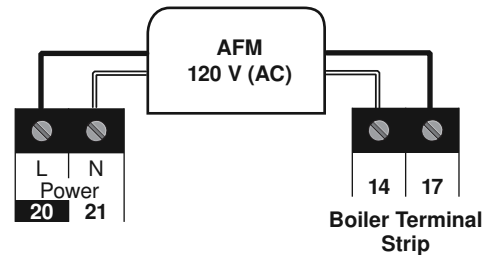


## STEP THIRTEEN ————— LOW WATER CUT OFF ON BOILER 2 —————

If a second Ultra Oil is installed with a Low Water Cut Off (LWCO), connect a single 18 AWG or similar wire from terminal 19 on the AFM to the alarm output on the LWCO.

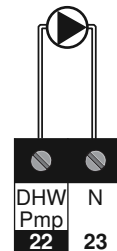
## STEP FOURTEEN ————— 120 V (AC) POWER —————

The wire labeled “AFM 120V(ac)” is used to power the AFM. Connect the black wire from terminal 20 on the AFM to terminal 17 on the Boiler Terminal Strip. Connect the white wire from terminal 21 on the AFM to terminal 14 on the Boiler Terminal Strip.



## STEP FIFTEEN ————— DHW PUMP —————

If the Ultra Oil is to provide heat to an indirect domestic hot water tank, connect the DHW pump to terminals 22 and 23 on the AFM using 18 AWG or similar wire.



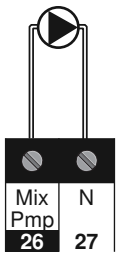
## STEP SIXTEEN ————— PRIMARY PUMP —————

The primary pump provides circulation through the high temperature loop. Connect the primary pump to terminals 24 and 25 on the AFM using 18 AWG or similar wire.



**STEP SEVENTEEN — MIX PUMP**

The mix pump provides circulation through the mix temperature loop. If required, connect the mix pump to terminals 26 and 27 on the AFM using 18 AWG or similar wire.



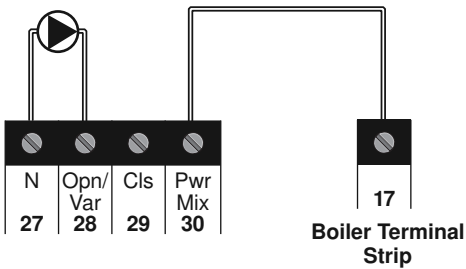
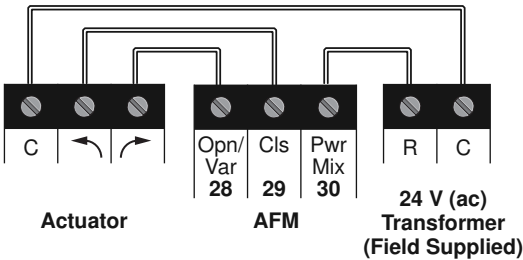
**STEP EIGHTEEN — MIXING DEVICE**

**A) Floating Action**

If using a floating action actuator and mixing valve, a 24 V (ac) external transformer is required. Connect the “R” on the transformer to terminal 30 on the AFM using 18 AWG or similar wire. Terminal 28 on the AFM is used to power the actuator motor open. Connect terminal 28 to either the clockwise or counter clockwise terminal on the actuator as required. Terminal 29 on the AFM is used to power the actuator motor closed. Connect terminal 29 to either the clockwise or counter clockwise terminal on the actuator as required. The “Common” on the transformer connects to the common terminal on the actuator.

**B) Variable Speed Injection Mixing Pump**

If using a variable speed injection mixing pump, connect 120 V (ac) Line voltage to terminal 30 on the AFM using 18 AWG or similar wire. The variable speed injection mixing pump connects to terminals 28 and 27 using 18 AWG or similar wire. The power connected to terminal 30 (Pwr Mix) must be the same or opposite phase as the power on terminal 21 (L).

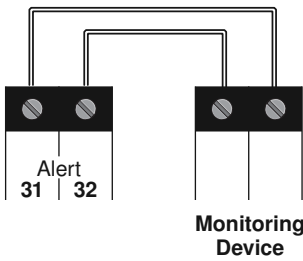


**STEP NINETEEN — ALERT**

An Alert dry contact is available on the AFM that allows connection to an external monitoring device, such as a security system. Use 18 AWG or similar wire to connect terminals 31 and 32 to the external monitoring device.

**INSTALLATION COMPLETED**

The AFM wiring is now complete. Power to the Ultra Oil can now be switched on.



## Cleaning the AFM

The Advanced Features Module and the Remote Display Module can be cleaned using a damp cloth while the power is off. Moisten the cloth with water and wring out prior to wiping the AFM and RDM. Do not use solvents or cleaning solutions.

## Control Settings

DIP Switch  
Settings  
Page 36

Access  
Levels  
Page 36

View  
Menu  
Page 36-37

Adjust  
Menu  
Page 38-40

Monitor  
Menu  
Page 41-42

Miscellaneous  
Menu  
Page 43

## DIP Switch Settings

The front of the AFM includes a single DIP switch that either Locks or Unlocks the Access Level item in the Miscellaneous (MISC) menu. Once Locked, the access level item is not longer shown on the Remote Display Module and the access level remains at the last setting. To indicate if the AFM is currently locked or unlocked, a symbol representing a padlock is shown in the lower right hand corner of the display.

### DIP switch



To prevent the Access Level item in the Miscellaneous menu from being viewed or adjusted, set the Lock /Unlock DIP switch to the Lock position.

## Access Levels

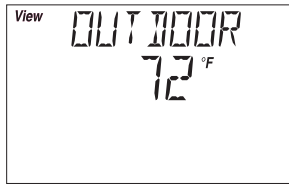

The Advanced Features Module allows for two access levels while navigating the items within each menu. The advanced (ADV) access level allows access to all settings on the AFM. The installer (INST) access level reduces the number of items that are visible. Once the AFM has been installed, select the appropriate access level for the people that deal with the control on a regular basis.

To change access levels:

- 1) Ensure the DIP switch is set to the Unlock position.
- 2) Press and release the Menu button on the Remote Display Module until the Miscellaneous menu is found.
- 3) Press and release the Item button until the Access item is found.
- 4) Press and release the Up or Down button to select either Advanced or Installer access level.

## View Menu (1 of 2)

The View menu shows the current operating temperatures and the status of the control.

Display	Section	Access	Description	Range
	A	ADV INST	<b>OUTDOOR</b> The current outdoor air temperature as measured by the outdoor sensor. <b>Note:</b> This item is not available when Outdoor Design is set to OFF.	-67 to 149°F (-55.0 to 65.0°C)
	E	ADV INST	<b>MIX SUPPLY</b> The current mix supply temperature as measured by the mix supply sensor. <b>Note:</b> This item is not available when Outdoor Design is set to OFF or Mixing is set to OFF.	-31 to 266°F (-35.0 to 130.0°C)



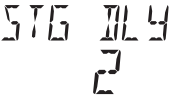



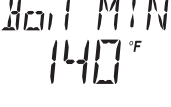

Display	Section	Access	Description	Range
View MIX TRG 155 °F	E	ADV	<b>MIX TARGET</b> The target mix supply temperature the AFM is trying to maintain at the mix sensor location. “— — —” indicates that there is presently no Mix Demand. <b>Note:</b> This item is not available when Outdoor Design is set to OFF or Mixing is set to OFF.	— — —, 35 to 230°F (— — —, 1.5 to 110.0°C)
View Boil SUP 175 °F	B	ADV INST	<b>BOILER SUPPLY</b> The current boiler supply temperature as measured by the boiler supply sensor.	-31 to 266°F (-35.0 to 130.0°C)
View Boil TRG 185 °F	B	ADV	<b>BOILER TARGET</b> The target boiler supply temperature the AFM is trying to maintain at the boiler sensor location. “— — —” indicates that there is presently no Boiler, Mix, DHW, or Setpoint Demand.	— — —, 35 to 230°F (— — —, 1.5 to 110.0°C)
View Boil DEM ON	A B	ADV INST	<b>BOILER DEMAND</b> Indicates whether or not the high temperature thermostat or end switch is calling for heat on the Boiler Demand.	OFF, ON
View MIX DEM ON	A E	ADV INST	<b>MIX DEMAND</b> Indicates whether or not the low temperature thermostat or end switch is calling for heat on the Mix Demand. <b>Note:</b> This item is not available when Outdoor Design is set to OFF or Mixing is set to OFF.	OFF, ON
View DHW DEM OFF	A C	ADV INST	<b>DHW DEMAND</b> Indicates whether or not the indirect domestic hot water tank aquastat is calling for heat on the DHW Demand.	OFF, ON
View SETP DEM OFF	A D	ADV INST	<b>SETPOINT DEMAND</b> Indicates whether or not the setpoint device is calling for heat on the Setpoint Demand.	OFF, ON
View STATUS MIN	A	ADV INST	<b>STATUS</b> Provides the operational status of the AFM. Indicates if the AFM is presently in Warm Weather Shut Down (WWSD), or has reached a Boiler Minimum (B.MIN), Boiler Maximum (B.MAX), Mix Minimum (M.MIN) or Mix Maximum (M.MAX) temperature. OFF is shown when there are no demands present. ON is shown when demands are present.	OFF ON WWSD B.MIN B.MAX M.MIN M.MAX

## Adjust Menu (1 of 3)


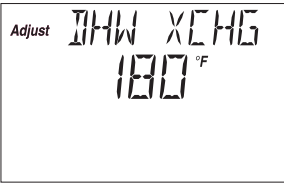
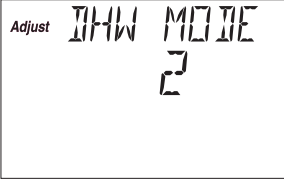

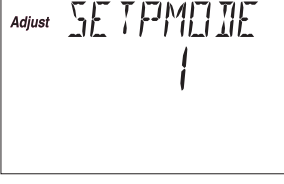
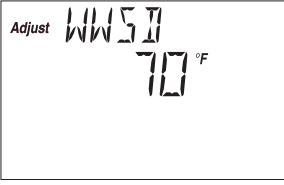

The Adjust menu allows the installer to enter the settings that affect the control operating temperatures and pump operation.

Display	Section	Access	Description	Default	Range
Adjust OUT DSGN 10 °F	A	ADV INST	<b>OUTDOOR DESIGN</b> The outdoor design air temperature used in the heat loss calculations to size the heating equipment. The outdoor design is typically set to the coldest annual temperature. By setting the outdoor design to Off, the outdoor reset operation of the AFM is shut off and no outdoor sensor is required.	10 °F (-12.0 °C)	-60 to 50 °F, OFF (-51.0 to 10.0 °C, OFF)
Adjust MIXING VAR	E	ADV	<b>MIXING</b> Select whether a variable speed injection pump or a floating action valve is to be connected to the AFM. Select Off if no mixing device is connected. <b>Note:</b> This item is not available when Outdoor Design is set to OFF.	VAR	VAR FLOT OFF
Adjust MIX ROOM 70 °F	E	ADV INST	<b>MIX ROOM</b> The desired room air temperature for mix temperature heating zones. <b>Note:</b> This item is not available when Outdoor Design is set to OFF or when Mixing is set to OFF.	70 °F (21.0 °C)	35 to 100 °F (-1.5 to -38.0 °C)
Adjust MIX DSGN 120 °F	E	ADV	<b>MIX DESIGN</b> The mix design water temperature required to heat the mix zones on the coldest day of the year. <b>Note:</b> This item is not available when Outdoor Design is set to OFF or when Mixing is set to OFF.	120 °F (49.0 °C)	70 to 200 °F (21.0 to 93.5 °C)
Adjust MIX MIN OFF	E	ADV	<b>MIX MINIMUM</b> The minimum allowed mix target water temperature. <b>Note:</b> This item is not available when Outdoor Design is set to OFF or when Mixing is set to OFF.	OFF	OFF, 35 to 150 °F (OFF, 1.5 to 65.5 °C)
Adjust MIX MAX 140 °F	E	ADV	<b>MIX MAXIMUM</b> The maximum allowed mix target water temperature. <b>Note:</b> This item is not available when Outdoor Design is set to OFF or when Mixing is set to OFF.	140 °F (60.0 °C)	80 to 200 °F (26.5 to 93.5 °C)
Adjust MOTR SPD 105 sec	E	ADV	<b>MOTOR SPEED</b> The time that the actuating motor requires to operate from fully closed to fully open. <b>Note:</b> This item is only available when Outdoor Design is set to a temperature or when Mixing is set to FLOT.	105 sec	30 to 230 sec
Adjust Boil 1 AUTO	B	ADV INST	<b>BOILER 1</b> Select whether boiler 1 is operational or not.	AUTO	AUTO OFF

## Adjust Menu (2 of 3)

Display	Section	Access	Description	Default	Range
Adjust 	B	ADV INST	<b>BOILER 2</b> Select whether boiler 2 is operational or not.	OFF	AUTO OFF
Adjust 	B	ADV INST	<b>ROTATE</b> Sets the rotation time for the two boilers. This item is used by the Equal Run Time Rotation function. <b>Note:</b> This item is only available when Boiler 1 and Boiler 2 are set to AUTO.	48 hr	10 to 72 hr, OFF
Adjust 	B	ADV	<b>STAGE DELAY</b> The minimum time delay the second boiler must wait after the first boiler fires. <b>Note:</b> This item is only available when Boiler 1 and Boiler 2 are set to AUTO.	2	1, 2, 3
Adjust 	B	ADV INST	<b>BOILER ROOM</b> The desired room air temperature for boiler temperature heating zones. <b>Note:</b> This item is only available when Outdoor Design is not set to OFF.	70°F (21.0°C)	35 to 100°F (1.5 to 38.0°C)
Adjust 	B	ADV INST	<b>BOILER TARGET</b> The boiler water target temperature when not using outdoor reset and a Boiler Demand is present. <b>Note:</b> This item is only available when Outdoor Design is set to OFF.	180°F (82.5°C)	140 to 210°F (60.0 to 99.0°C)
Adjust 	B	ADV	<b>BOILER DESIGN</b> The boiler design water temperature required to heat the high temperature zones on the coldest day of the year. <b>Note:</b> This item is only available when Outdoor Design is not set to OFF.	180°F (82.5°C)	140 to 210°F (60.0 to 99.0°C)
Adjust 	A B E	ADV INST	<b>BOILER MINIMUM</b> The minimum allowed boiler target water temperature. <b>Note:</b> This item is only available when Outdoor Design is not set to OFF.	140°F (60.0°C)	140 to 180°F (60.0 to 82.5°C)
Adjust 	B	ADV	<b>BOILER MAXIMUM</b> The maximum allowed boiler target water temperature. <b>Note:</b> This item is only available when Outdoor Design is not set to OFF.	200°F (93.5°C)	140 to 210°F (60.0 to 99.0°C)

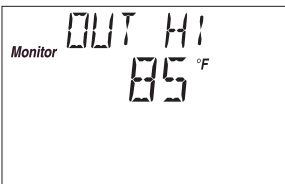
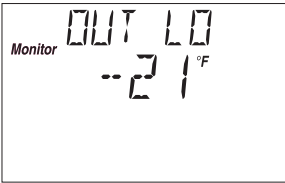
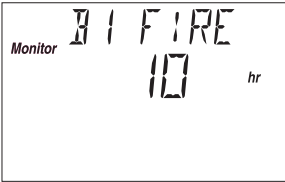
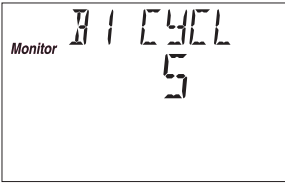
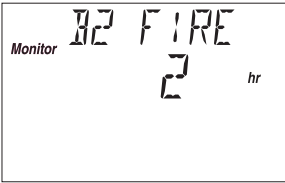
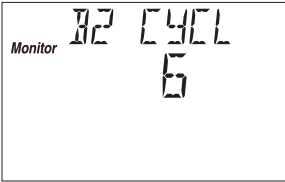
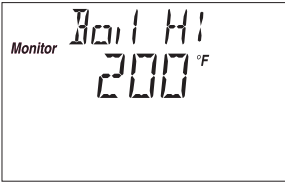
## Adjust Menu (3 of 3)

Display	Section	Access	Description	Default	Range
Adjust 	B	ADV	<b>BOILER DIFFERENTIAL</b> The temperature differential that the AFM is to use when it is operating the boiler(s). The boiler differential cycles 1/2 above and 1/2 below the boiler target.	AUTO	AUTO, 2 to 42°F (AUTO, 1.0 to 23.5°C)
Adjust 	C	ADV INST	<b>DHW EXCHANGE</b> The minimum boiler supply temperature to the DHW heat exchanger during a DHW Demand.	180°F (82.0°C)	OFF, 140 to 210°F (OFF, 60.0 to 99.0°C)
Adjust 	C	ADV	<b>DHW MODE</b> Selects whether the primary pump is required during a DHW Demand. Allows the selection of DHW to have priority over the heating system.	2	1, 2, 3
Adjust 	D	ADV INST	<b>SETPOINT</b> The minimum boiler supply temperature during a Setpoint Demand.	180°F (82.0°C)	OFF, 140 to 210°F (OFF, 60.0 to 99.0°C)
Adjust 	D	ADV	<b>SETPOINT MODE</b> Selects whether the primary pump is required during a Setpoint Demand.	1	1, 2
Adjust 	A	ADV INST	<b>WARM WEATHER SHUT DOWN</b> Locks out the space heating system once the outdoor air temperature exceeds the Warm Weather Shut Down (WWSD) setting. WWSD does not apply to DHW Demands or to Setpoint Demands. <b>Note:</b> This item is only available when Outdoor Design is not set to OFF.	70°F (21.0°C)	35 to 100°F, OFF (1.5 to 38.0°C, OFF)
Adjust 	F	ADV	<b>PURGE</b> The maximum length of time the primary pump will continue to operate after all heat demands are removed.	0:20 min	OFF, 0:10 to 40:00 min

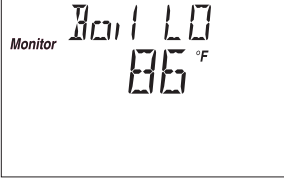
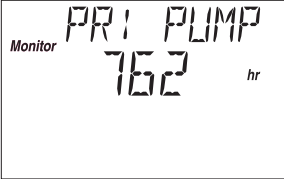
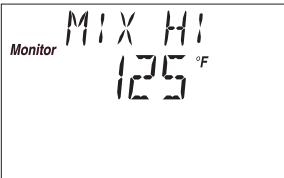
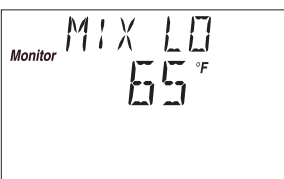
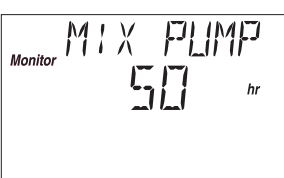
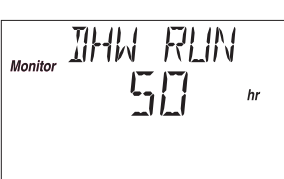
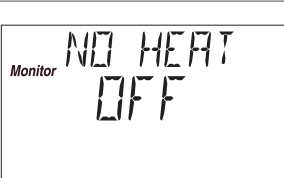


## Monitor Menu (1 of 2)

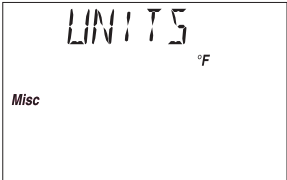


The Monitor Menu records temperature highs and lows, as well run time and the number of cycles of the boiler and pumps.

Display	Access	Description	Range
	ADV INST	<b>OUTDOOR HIGH</b> The highest recorded temperature by the outdoor sensor. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Outdoor Design is not set to OFF.	-67 to 149°F (-55.0 to 65.0°C)
	ADV INST	<b>OUTDOOR LOW</b> The lowest recorded temperature by the outdoor sensor. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Outdoor Design is not set to OFF.	-67 to 149°F (-55.0 to 65.0°C)
	ADV INST	<b>BOILER 1 FIRE</b> The total number of running hours of boiler 1. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Boiler 1 is set to AUTO.	0 to 9999 hr
	ADV INST	<b>BOILER 1 CYCLES</b> The number of firing cycles of boiler 1. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Boiler 1 is set to AUTO.	0 to 9999
	ADV INST	<b>BOILER 2 FIRE</b> The total number of running hours of boiler 2. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Boiler 2 is set to AUTO.	0 to 9999 hr
	ADV INST	<b>BOILER 2 CYCLES</b> The number of firing cycles of boiler 2. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Boiler 2 is set to AUTO.	0 to 9999
	ADV INST	<b>BOILER HIGH</b> The highest temperature recorded at the boiler supply sensor. Press and hold the Up and Down buttons to clear.	0 to 255°F (-17.0 to 124.0°C)

## Monitor Menu (2 of 2)

Display	Access	Description	Range
 <p>Monitor BOILER LOW 86 °F</p>	ADV INST	<b>BOILER LOW</b> The lowest temperature recorded at the boiler supply sensor. Press and hold the Up and Down buttons to clear.	0 to 255°F (-17.0 to 124.0°C)
 <p>Monitor PRIMARY PUMP 762 hr</p>	ADV INST	<b>PRIMARY PUMP</b> The total number of running hours for the primary pump. Press and hold the Up and Down buttons to clear.	0 to 9999 hr
 <p>Monitor MIX HI 125 °F</p>	ADV INST	<b>MIX HIGH</b> The highest temperature recorded at the mix sensor. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Mixing is not OFF and Outdoor Design is not OFF.	0 to 255°F (-17.0 to 124.0°C)
 <p>Monitor MIX LO 65 °F</p>	ADV INST	<b>MIX LOW</b> The lowest temperature recorded at the mix sensor. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Mixing is not OFF and Outdoor Design is not OFF.	0 to 255°F (-17.0 to 124.0°C)
 <p>Monitor MIX PUMP 50 hr</p>	ADV INST	<b>MIX PUMP</b> The total number of running hours for the mix pump. Press and hold the Up and Down buttons to clear. <b>Note:</b> This item is only available when Mixing is not OFF and Outdoor Design is not OFF.	0 to 9999 hr
 <p>Monitor DHW RUN 50 hr</p>	ADV INST	<b>DHW RUN</b> The total number of running hours for the DHW pump. Press and hold the Up and Down buttons to clear.	0 to 9999 hr
 <p>Monitor NO HEAT OFF</p>	ADV	<b>NO HEAT</b> Provides an adjustable alarm if the boiler or mixing supply temperature does not increase within a set amount of time. <b>Note:</b> The default is OFF.	3 to 40 min, OFF

## Miscellaneous Menu (1 of 1)

Display	Access	Description	Default	Range
 <p>The display shows the word "UNITS" in large characters, with "°F" in smaller characters to the right. The word "Misc" is in the bottom left corner.</p>	ADV INST	<b>UNITS</b> Select either Fahrenheit or Celsius temperature units.	°F	°F, °C
 <p>The display shows the word "ACCESS" in large characters, with "INST" in smaller characters below it. The word "Misc" is in the bottom left corner.</p>	ADV INST	<b>ACCESS LEVEL</b> Select between Installer or Advanced access levels. <b>Note:</b> This item is only available when the DIP Switch is in the Unlock position.	INST	INST, ADV
 <p>The display shows the word "TYPE" in large characters, with "975" in smaller characters below it. The word "Misc" is in the bottom left corner.</p>	ADV INST	<b>TYPE</b> Displays model number of the AFM. By holding the Up button, the software version is displayed by cycling the first 3 numbers followed by the last 3 numbers.	975	975

## Testing & Troubleshooting

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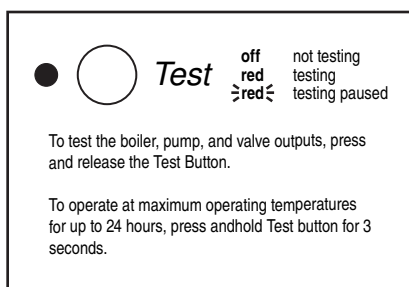
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### Testing the AFM

The Advanced Features Module has a built in test routine which is used to test the main control functions. The AFM continually monitors the sensors and displays an error message whenever a fault is found. See the following pages for a list of the AFM's error messages and possible causes. When the Test button is pressed, the Test light is turned on. The individual outputs and relays are tested in the following test sequence.

#### TEST SEQUENCE

Pressing the Test button starts the test routine. During the test routine, the test sequence can be paused by pressing the Test button. While paused, the AFM displays the testing step as well as the word PAUS. If the Test button is not pressed again for 5 minutes while the test sequence is paused, the AFM exits the entire test routine. If the test sequence is paused, the Test button can be pressed again to advance to the next step. This can also be used to rapidly advance through the test sequence. To reach the desired step, repeatedly press and release the Test button until the appropriate device and segment in the display turn on.



Each step in the test sequence lasts 10 seconds.

**STEP 1:** The mixing device ramps up to 100% or full open for 10 seconds then shuts off or closes.

**STEP 2:** The mixing system pump turns on for 10 seconds then shuts off. The step may be paused if a call for heat is present.

**STEP 3:** The primary pump turns on for 10 seconds and remains on. The step may be paused if a call for heat is present.

**STEP 4:** IF Boiler 1 = AUTO

The boiler 1 contact turns on for 30 seconds and then shuts off. The step may be paused if a call for heat is present.

**STEP 5:** IF Boiler 2 = AUTO

The boiler 2 contact turns on for 30 seconds and then shuts off. The step may be paused if a call for heat is present.

**STEP 6:** The DHW pump contact turns on together with the primary pump if necessary for 10 seconds. The step may be paused if a DHW Demand is present.

#### MAX HEAT

The AFM has a function called Max Heat. In this mode, the AFM turns on and operates the system up to the maximum set temperatures as long as there is a demand for heat. The AFM continues to operate in this mode for up to 24 hours or until either the Item, Menu or Test button is pressed. This mode may be used for running all circulators during system start-up in order to purge air from the piping. To enable the Max Heat feature, use the following procedure.

- 1) Press and hold the Test button for more than 3 seconds. At this point, the AFM displays the words MAX HEAT and the word NO.
- 2) Using the Up or Down buttons, select the word YES. After 3 seconds, the AFM flashes the word MANUAL and Boil MAX is the target boiler supply water temperature.
- 3) To cancel the Max Heat mode, press either the Item, Menu, or Test button.
- 4) Once the Max Heat mode has either ended or is cancelled, the AFM resumes normal operation.

## Testing the Sensors

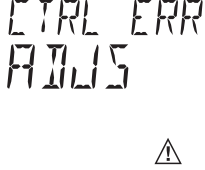

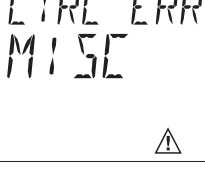
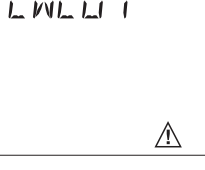
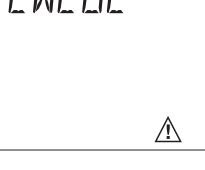


A good quality test meter capable of measuring up to 5,000 k $\Omega$  (1 k $\Omega$  = 1000  $\Omega$ ) is required to measure the sensor resistance. In addition to this, the actual temperature must be measured with either a good quality digital thermometer, or if a thermometer is not available, a second sensor can be placed alongside the one to be tested and the readings compared.

First measure the temperature using the thermometer and then measure the resistance of the sensor at the AFM. The wires from the sensor must not be connected to the AFM while the test is performed. Using the chart below, estimate the temperature measured by the sensor. The sensor and thermometer readings should be close. If the test meter reads a very high resistance, there may be a broken wire, a poor wiring connection or a defective sensor. If the resistance is very low, the wiring may be shorted, there may be moisture in the sensor or the sensor may be defective. To test for a defective sensor, measure the resistance directly at the sensor location.








Do not apply voltage to a sensor at any time as damage to the sensor may result.

Temperature		Resistance	Temperature		Resistance	Temperature		Resistance	Temperature		Resistance
°F	°C	$\Omega$	°F	°C	$\Omega$	°F	°C	$\Omega$	°F	°C	$\Omega$
-50	-46	490,813	20	-7	46,218	90	32	7,334	160	71	1,689
-45	-43	405,710	25	-4	39,913	95	35	6,532	165	74	1,538
-40	-40	336,606	30	-1	34,558	100	38	5,828	170	77	1,403
-35	-37	280,279	35	2	29,996	105	41	5,210	175	79	1,281
-30	-34	234,196	40	4	26,099	110	43	4,665	180	82	1,172
-25	-32	196,358	45	7	22,763	115	46	4,184	185	85	1,073
-20	-29	165,180	50	10	19,900	120	49	3,760	190	88	983
-15	-26	139,402	55	13	17,436	125	52	3,383	195	91	903
-10	-23	118,018	60	16	15,311	130	54	3,050	200	93	829
-5	-21	100,221	65	18	13,474	135	57	2,754	205	96	763
0	-18	85,362	70	21	11,883	140	60	2,490	210	99	703
5	-15	72,918	75	24	10,501	145	63	2,255	215	102	648
10	-12	62,465	80	27	9,299	150	66	2,045	220	104	598
15	-9	53,658	85	29	8,250	155	68	1,857	225	107	553

## Error Messages (1 of 2)

<p>View</p> 	<p><b>CONTROL ERROR ADJUST MENU</b></p> <p>The AFM was unable to read a piece of information stored in the Adjust menu. Because of this, the AFM was required to load the factory settings into all of the items in the Adjust menu. The AFM will stop operation until all of the items available in the Adjust menu of the AFM have been checked by the user or installer.</p> <p><b>Note:</b> The access level must be in Advanced in order to clear the error.</p>
<p>View</p> 	<p><b>CONTROL ERROR MONITOR MENU</b></p> <p>The AFM was unable to read a piece of information stored in the Monitor menu. Because of this, the AFM was required to load the factory settings into all of the items in the Monitor menu. The AFM will continue to display the error message until all of the items available in the Monitor menu of the AFM have been checked by the user or installer.</p> <p><b>Note:</b> The access level must be in Advanced in order to clear the error.</p>
<p>View</p> 	<p><b>CONTROL ERROR MISCELLANEOUS MENU</b></p> <p>The AFM was unable to read a piece of information stored in the Miscellaneous menu. Because of this, the AFM was required to load the factory settings into all of the items in the Miscellaneous menu. The AFM will continue to display the error message until all of the items available in the Miscellaneous menu of the AFM have been checked by the user or installer.</p> <p><b>Note:</b> The access level must be in Advanced in order to clear the error.</p>
<p>View</p> 	<p><b>LOW WATER CUT OFF 1</b></p> <p>The AFM has received a LWCO alert from boiler 1. The AFM will not operate boiler 1 until the LWCO 1 alert signal has been removed. Once the LWCO 1 alert has been removed, press the Menu or Item button to clear the error message.</p>
<p>View</p> 	<p><b>LOW WATER CUT OFF 2</b></p> <p>The AFM has received a LWCO alert from boiler 2. The AFM will not operate boiler 2 until the LWCO 2 alert signal has been removed. Once the LWCO 2 alert has been removed, press the Menu or Item button to clear the error message.</p>
<p>View</p> 	<p><b>OUTDOOR SENSOR SHORT CIRCUIT</b></p> <p>The AFM is no longer able to read the Outdoor sensor due to a short circuit. In this case the AFM assumes an outdoor temperature of 32°F (0°C) and continues operation. Locate and repair the problem as described in the Testing the Sensors section. To clear the error message from the AFM after the sensor has been repaired, press either the Menu or Item button.</p>
<p>View</p> 	<p><b>OUTDOOR SENSOR OPEN CIRCUIT</b></p> <p>The AFM is no longer able to read the Outdoor sensor due to an open circuit. In this case the AFM assumes an outdoor temperature of 32°F (0°C) and continues operation. Locate and repair the problem as described in the Testing the Sensors section. To clear the error message from the AFM after the sensor has been repaired, press either the Menu or Item button.</p>

## Error Messages (2 of 2)

<p>View</p> 	<p><b>MIX SUPPLY SHORT CIRCUIT</b></p> <p>The AFM is no longer able to read the mix supply sensor due to a short circuit. In this case, the AFM operates the mixing device at a fixed output as long as there is a mixing demand. Locate and repair the problem as described in the Testing the Sensors section. To clear the error message from the AFM after the sensor has been repaired, press either the Menu or Item button.</p>
<p>View</p> 	<p><b>MIX SUPPLY OPEN CIRCUIT</b></p> <p>The AFM is no longer able to read the mix supply sensor due to an open circuit. In this case, the AFM operates the mixing device at a fixed output as long as there is a mixing demand. Locate and repair the problem as described in the Testing the Sensors section. To clear the error message from the AFM after the sensor has been repaired, press either the Menu or Item button.</p>
<p>View</p> 	<p><b>BOILER SUPPLY SENSOR SHORT CIRCUIT</b></p> <p>The AFM is no longer able to read the boiler sensor due to a short circuit. The AFM closes the Boiler 1 or Boiler 2 contact when there is a call for heat in the system. The boiler temperature is limited by the high limit aquastat. Locate and repair the problem as described in the Testing the Sensors section. To clear the error message from the AFM after the sensor has been repaired, press either the Menu or Item button.</p>
<p>View</p> 	<p><b>BOILER SUPPLY SENSOR OPEN CIRCUIT</b></p> <p>The AFM is no longer able to read the boiler sensor due to an open circuit. The AFM closes the Boiler 1 or Boiler 2 contact when there is a call for heat in the system. The boiler temperature is limited by the high limit aquastat. Locate and repair the problem as described in the Testing the Sensors section. To clear the error message from the AFM after the sensor has been repaired, press either the Menu or Item button.</p>
<p>View</p> 	<p><b>NO HEAT BOILER</b></p> <p>A warning message is displayed when the boiler supply does not increase to the target temperature within the time set by the NO HEAT item in the Monitor menu. This indicates a possible problem with the boiler(s). Press either the Menu or Item button to clear the error message.</p>
<p>View</p> 	<p><b>NO HEAT MIX</b></p> <p>A warning message is displayed when the mix supply does not increase to the target temperature within the time set by the NO HEAT item in the Monitor menu. This indicates a possible problem with the mixing device or pumps. Press either the Menu or Item button to clear the error message.</p>
<p>View</p> 	<p><b>FREEZE PROTECTION</b></p> <p>The boiler supply sensor measured a temperature at or below 40°F (4.5°C). The AFM has switched on the primary pump and fired the boiler(s) in order to provide freeze protection. Freeze protection stops once the boiler supply sensor exceeds 45°F (7.5°C). Press either the Menu or Item button to clear the error message.</p>

## Technical Data

### AFM Advanced Features Module

Literature	Weil-McLain Advanced Features Module (AFM) Installation and Operating Manual
Control	Microprocessor PID control; This is <b>not a safety (limit) control</b>
Packaged weight	3.1 lbs. (1.42 kg)
Dimensions	6-5/8" H x 5-1/32" W x 2-7/16" D (170 x 128 x 62 mm)
Approvals	CSA C US, meets ICES & FCC regulations for EMI / RFI
Ambient conditions	Indoor use only, 32 to 150°F (0 to 65°C)
	RH ≤ 92% below 104°F (40°C), down to 50% above 104°F (40°C)
	Altitude <3000 m, Installation Category II, Pollution Category 2
Power Supply	120 V (ac) + 10%, -15% 60 Hz 1100 VA
Variable Pump	120 V (ac) 2.4 A 1/6 hp, fuse T2.5 A
Relays	120 V (ac) 3 A 1/6 hp, pilot duty 240 VA
Demand	Non-powered contact closure
Sensors included	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) β=3892
	2 of Universal Sensor 917-12
	1 of Outdoor Sensor 916-12



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